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IT will be recollected that some time subsequent to the death of ALEXANDER L. HOLLEY, the American Institute of Mining Engineers, the American Society of Civil Engineers and the American Society of Mechanical Engineers raised a fund of $10,000 for the purpose of erecting a suitable monument to his memory to be placed in one of the parks in this city. A bronze memorial bust was decided on, and the making of the design was entrusted to Mr. J. Q. A. WARD, the well-known sculptor. We are glad to note its approaching completion. About a week ago it was successfully cast by the Henry Bonnard Bronze Company in West Sixteenth street, this city. It is now in the finishing shops, and when completed will be dedicated with appropriate ceremonies by the three societies.

IT will be remembered that some enterprising Associated Press agent startled the country a few weeks ago by announcing that the Standard Oil Company had wired from the Media works to Philadelphia for two hundred bull-dogs, which news item the telegraph editors and "home correspondents" of some of the metropolitan dailies ingeniously enlarged into a small-sized sensation lasting a day or two until it was discovered that the "bull-dogs" wanted were merely harmless lifting-jacks of a particular style. As an example of how so much remarkable literature is floated, observe the following judicial and editorial comment of one of our technical exchanges in its issue of June 22d, at which late date it does not seem to have yet "caught on":

> The Standard Oil Company has, however, introduced a new style of watchman which we think will be efficient. The company has suffered a good deal by tramps and loafers getting too near its tanks and smoking, and thus setting fire to the gas generated by the oil, which ignites easily; and it has now given an order to a dog fancier's association for two hundred bull dogs, to range in age from six months to a year, the price to be $15 each. The dogs are to be placed where the company has distributing stations, and used in the field to guard the large iron tanks that are full of oil. The bull-dog watchman certainly has this merit over the average biped private watchman, that he neither smokes, drinks nor goes to sleep on watch.

THE CHESAPEAKE & OHIO CANAL.

It seems quite probable, as announced in the ENGINEERING AND MINING JOURNAL, June 8th, that this old and formerly prominent waterway may soon pass out of existence; although the action taken by the stockholders at the recent meeting showed that hope of resuscitation had not altogether disappeared. The management was called upon to put forth its best efforts to raise money enough to cover the repairs instantly demanded; but it is doubtful what success will be reached. The damage caused by the late freshets was so great as to apparently preclude the hope of repair under the existing management. For a long time the canal had been operated at a loss, and its maintenance was only due to the aid granted by the State of Maryland. There are $500,000 repair bonds out, besides $1,700,000 old non-mortgage bonds, so that for the present owners to re-establish it as an artery of commerce will be to assume a rather heavy load under the ruling conditions of traffic. The property is rated, according to one estimate, at about $1,000,000 if brought to a forced sale. While there was faint prospect of its being taken up and operated as a canal by a new organization strong enough to incur the cost of repairs, or of its being put in working condition by the State, the property has a decided value as a road-bed and right of way, and should the present movement fail, the future fate of the canal is not uncertain. Several railroad corporations, among them the Baltimore & Ohio, the Pennsylvania, and the Western Maryland, are said to have an eye on it. Of these roads, we understand that the Baltimore & Ohio already holds $252,000 of the $500,000 old bonds, or a controlling interest. If, therefore, the canal management succeeds in floating a new issue of, say, $300,000, and the new bonds do not fall into the hands of the Baltimore & Ohio, that road would lose the grip which it now has. The attempt will probably be made to have the new repair bonds, if issued, take precedence over the State lien; but there may be a hitch here. There will be some difficulty in disposing of a new issue at anything near par. If the canal is ultimately abandoned, it will add one more to the already considerable list of water-ways whose tow-paths have been taken for railroad beds, and its extinction would seriously affect interests along its course, more especially at its Georgetown outlet. The next session of the Maryland Legislature will be called upon to take action in the matter. It is stated that although operated at a financial loss, the indirect benefit to the State warranted former subsidies; but an increased aid is now hardly to be looked for, and this seems to have been recognized at the late meeting.

THE MEXICAN SILVER-LEAD ORE QUESTION.

IT is interesting to note the view taken in England of the possible reversal of the former Treasury rulings on the subject of the free admission of silver-lead ores. On the other side of the water they look upon this reversal as almost certain, and are already congratulating themselves on the increased business to England that will be the result of what they consider our suicidal policy.

We quote the following from the *Mining Journal*, of London, as a representative paper of the smelting industry of England:

> The effect of a ruling adverse to the present rendering of the law will be, in all probability, to divert the Mexican ores to European markets, and it is in this fact that the outcome of the agitation is of special interest to the metallurgical industry of this country. What, in the event of so desirable a decision, will be a gain to the smelting industry of Europe, will be a serious loss to the smelters of the Southwestern States of America, who are in no small measure dependent upon the Mexican supply, and upon which such smelting industry has been mainly built up. Whether the mining industries of the States as a whole would largely benefit from a curtailment of supply of the metal, even to the extent of 10 per cent, which the Mexican importations represent, is not at all a matter of certainty, for any advance in the value of lead would doubtless bring about equipollence by increased production in Idaho and other States now limited in productive power solely by the low value of the metal. The conflict of interests affords a prominent example of the anomalies of a protectionist policy, and it is somewhat amusing to see how the Republican press on the other side of the "pond," while struggling to avoid the acknowledgement of a single point derogatory to their protectionist policy, attempt to advocate the principles of free trade where it becomes a question of free trade or no trade at all.

It is much to be regretted that the interpretation of the laws should be deemed by such one-sided and imprudent party organs as the New York *Press* as a political instead of a legal question. That paper advocates the change in the ruling which would impose a duty on silver lead ores, not because it is a proper interpretation of the law, but because it would insure, it thinks, in Montana the success of the political party of which the *Press* is an "organ." This is simply disgraceful. Whatever the law may be it should be enforced, and if the interpretation which several successive official authorities have given it in the past be incorrect, or the intention of Congress be uncertain, it were better that the question of what Congress did intend be referred to Congress at its next session, and the only authoritative decision be thus obtained. There is certainly no such pressing need for changing the law as calls for an arbitrary change in long established rulings, especially where this change would effect great hardships and injury to vast industries that have been built up on faith of the existing official interpretation of the law.

The proposed action of the ultra protectionists well illustrates how "extremes meet," for the course they advocate on protectionist grounds is exactly that which the enemies of protection—free trade England—desires to see us adopt, for would it not divert the Mexican trade in silver-lead ore, and in every kind of merchandise which Mexico would take in exchange for it from this country to England. One would think that the undisguised satisfaction of our rivals in trade over the prospect of the destruction or blighting of our growing commerce with Mexico, would cause our ardent advocates of the Chinese policy to hesitate before adopting a course which seeks a shadowy and infinitesimal advantage to one department of an industry at the expense of the whole people. Nevertheless, should the law call for the total exclusion of foreign products, it should be obeyed, but Congress alone has power to change our laws.

THE COLORADO MEETING OF THE AMERICAN INSTITUTE OF MINING ENGINEERS.

The first session of the Colorado meeting of the American Institute of Mining Engineers was held in the High School building, Denver, Wednesday afternoon, June 19. Quite a large number of the members had by that time reached Denver, and a fair representation was therefore made at the formal opening exercises. During the morning a party of fifty or more inspected the Omaha & Grant smelting works. At the afternoon meeting Ex-Governor J. B. GRANT, Senator E. O. WOLCOTT and Mayor LONDONER welcomed the visitors to Colorado in hospitable speeches covering the engineers with flattering encomiums for work done in developing the resources of the State, and attributing to them many improvements leading to the more economical mining and reduction of ores. In the course of his remarks Senator WOLCOTT suggested the advisability of the mining engineers giving their attention to the elucidation of the mysteries of our United States mining laws in regard to titles, which looks like awarding a pretty big contract.

President RICHARD PEARCE then opened the regular proceedings with an address. This was followed by the reading of a paper on the Poetsch-Sooysmith method of shaft-sinking in quicksands by freezing, in which the experience at the Chapin iron mine was cited.

The second meeting was held at Denver, on the afternoon of the 20th, when Mr. CHARLES W. GOODALE, of Butte, Montana, read a paper on concentration, describing the immense plant at work in and around Butte. An animated discussion ensued. Mr. A. A. BLOW, superintendent of the Silver Cord mine, then read a paper on the ore deposits of Iron Hill, in which he combated the theory that the Leadville ores were derived from the leaching out of minerals originally contained in the overlying porphyry, exhibiting maps and diagrams in support of the argument.

On the same day the works of the Boston & Colorado Smelting and Refining Company at Argo were visited by a party of about seventy-five. At Denver headquarters were made at the Albany hotel.

On the 21st a special train took the members to Pueblo, where a reception and garden party, with an illumination and banquet, were tendered them on the grounds of the Colorado Smelting Company, where they were royally entertained by Mr. EILERS and other officers of the company. The Colorado Steel Works and the smelters about Pueblo were inspected.

On Saturday the party went to Manitou, and on Monday, the 24th, proceeded to Aspen, which interesting camp was studied in detail. Subsequently most of the visiting members went to Leadville, returning to Denver later in the week, when the party broke up. A full account of the proceedings will be given in the ENGINEERING AND MINING JOURNAL later.

STEAMERS FOR CARRYING ORE AND COAL.

A considerable increase in the number of steam vessels for carrying bulk cargoes, such as iron ore and coal, may be looked for in the near future, particularly in the lake trade, where already this season a marked advance has been made. Several of the larger mining companies would probably find it to their advantage to build and operate their own vessels, as the Cleveland Iron Mining Company is doing, and thus make themselves independent of outside transportation cliques, which have so often combined to force freight rates to the pinching point toward the close of the lake navigation season. In devising the best type of vessel to be adopted much thought is necessary; but as general rules it is safe to say that, for the lakes, steamers of medium speed are preferable to schooners and barges as being safer, quicker and altogether more reliable, a feature of great importance in the capricious lake weather; and that while iron is unquestionably far superior to wood, steel will be found a more economical material than iron, the saving in weight more than offsetting the apparent difference in first cost. Sailing vessels on the lakes are more or less farcical. They do very little sailing indeed, and their spars and rigging are rather incumbrances than helps The schooners generally travel as "consorts," that is, in company with steam cargo vessels, but the steamers do most of the work. In summer the winds are too light to move vessels with any certainty, and in autumn the clumsy schooners so long in vogue on the lakes, being modeled for cargo carrying and not for sailing, almost inevitably go ashore when a blow comes on, unless pulled out by a tug or steam freighter. They would probably do better without their masts. Now, as between a barge to be towed and a steam cargo vessel, it is cheaper to select the latter. The self-moving vessel is also free of danger from breaking hawsers, wild steering and other chances. Towed vessels of the ordinary type cannot compete on even terms. But the ingenious device adopted on the lakes last year, namely, suitably modeled submerged steel shells, taken in tow, seems to offer a possible alternative solution of the ore transportation problem. So far as we have learned, the novel craft towed easily, presenting but slight resisting surface to wind and head-sea action. It may be that such a type will take the lead in the end, but further experience will be needed to determine this. There are many other considerations to be taken into account besides the mere question of going through the water easily. The test of this season's work ought to settle the matter one way or the other, and the result will be awaited with interest.

Mr. W. E. GALLAGHER, superintendent of the steam colliers of the Philadelphia & Reading Railroad Company, who, from his experience with the boats of that company, should be good authority, writes us recommending iron or steel vessels of about 3 500 tons capacity, draught loaded of 20 feet, fitted with triple-expansion engines, with speed of 10 knots per hour when loaded. Vessels of such a type should be economical in running and successful ships. The Reading Company began building iron steam colliers in 1869 for carrying coal to Eastern ports, and has found them to be profitable. In 1874 the company's fleet consisted of fourteen steamers, carrying from 500 to 1,600 tons each, since which year four have been lost. Up to November 30th, 1888, these steamers (from ten to fourteen in the fleet) had made 7,122 voyages and had carried 8,048,508 tons of coal.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

The thirty-seventh annual convention of the American Society of Civil Engineers began its sessions at the Octagon House, Seabright, N. J., on June 20th. The convention organized by electing J. J. R. CROES, of New York, chairman. On Friday, THEODORE COOPER, of New York, read a paper upon "American Railroad Bridges." ONWARD BATES read another upon "Timber Trestle Bridges for Railways." Messrs. CHANUTE, BREITHAUPT, and WALLACE discussed the Sibley bridge. HENRY B. SEAMAN, of Philadelphia, read an interesting paper upon "Componential Trusses for Traveling Cranes." O. E. MICHAELIS, of Augusta, Me., read an essay upon lime sulphite fibre manufacture in the United States. J. E. WATKINS, of Washington, D. C., held the attention of the members of the convention with a paper upon "The Development of the American Rail and Track."

In the evening, MAX J. BECKER, of Pittsburgh, the President of the society, delivered the annual address.

On Saturday, June 22d, the papers and discussions were devoted to water supply, dams, reservoirs, and the following papers were read: "The Fresh Water Algæ and their relation to the Purity of Public Water Supplies," by GEORGE W. RAFTER; "Some Maximum Rainfalls in Boston," by DESMOND FITZGERALD.

Mr. FTELEY said that, as the committee appointed to investigate the South Fork dam was having extensive surveys made, the full report would be delayed until they were complete. Much detailed information was given by engineers who had visited or were familiar with the work, but the main facts are simply as given in this paper immediately after the accident, that the dam in itself, though well built for an earthen dam of this kind in the first place, was badly repaired by the fishing club, and, while strong enough to resist the pressure on it, its failure was due to the partial obstruction of the waste weir, and to the lowering of the crest of the dam, especially in the middle, which reduced the effective depth of the weir or spillway. In other words, had the dam been higher it would have been more durable.

On Monday, June 24th, the business meeting was held at 10 A. M., after which the following papers were announced for reading and discussion: "Ship Canals," by R. E. PEARY; "Flood Heights in the Mississippi River," by WILLIAM STARLING, and "Highway Improvement," by O. H. LANDRETH. The session continued until 4 o'clock, and among the business was the adoption of a resolution calling for the appointment of three experts to investigate the causes of impurity in the water supplies of the large cities, and to recommend measures of improvement. Also, a special committee was appointed to revise the constitution of the society. The society elected the following nominating committee: STEVENSON TOWLE, of New York; Major MICHAELIS, of the United States Army; FREDERICK H. SMITH, of Baltimore; ARTHUR MACY, of Colorado, and J. N. WALLACE, of St Louis. Late in the afternoon the members inspected the system of filtering in the water-works at Long Branch. In the evening at the annual banquet of the society over three hundred covers were laid.

On Tuesday the exercises included the report of the special committee of railroad engineers appointed to report upon the proper form of railway car wheels and railway rails. Prof. O. H. LANDRETH, of Nashville, Tenn., followed with a paper upon the influence of temperature during settling on the strength of cement mortars. E. RUSSELL TRATMAN, of Brooklyn, read two papers, the first upon the improvement of railway tracks and the second upon metal tracks for railways.

Altogether, the convention was an extremely interesting one. Space will be given in these pages at an early date for discussion of several of the more important papers.

THE DECLINE IN BUSINESS IN MINING SHARES IN NEW YORK.

The recent report of the Committee on Mining Securities of the Consolidated Exchange, of New York, for the year 1888-9 shows a decline of more than 25 per cent in business over the preceding year, being represented by 5,360,067 against 6,934,513 shares, and the total number

traded in scarcely reaches 50 per cent of the amount dealt in in the year 1886–7.

This record is a strange one, when the general condition of the mining industry of the country is taken into account, as most certainly the period under review, since 1886, has shown a steady and profitable development of the mineral resources of the States and Territories in every direction. There has been, it is true, no inflation of speculation, no new opening up of such districts as Leadville, and no extensive "booming;" but the amount distributed in dividends of such companies as are quoted and dealt in, has steadily and perceptibly increased, the amount so distributed in 1886 being $10,282,095; in 1887, $10,515,753, and in 1888 $13,061,105. This should have had a tendency to increase rather than diminish business, more especially as the increase was owing to most of the old dividend-paying properties continuing to pay and augmenting their dividends, rather than to new properties taking the place of old ones that had ceased to be profitable. This fact alone should have tended to increase confidence in the stability of mining investments, and therefore to have multiplied transactions, in addition to which the history of the returns from the various mining centers covering all the far more numerous private investments, has shown that mining was never in the history of this country carried on so profitably or in such a business like manner as during the past three years.

One very obvious reason for the decline in business is the character for the large majority of the stocks listed on the Consolidated Exchange, many of the enterprises represented by these stocks being "wild cats" or frauds, condemned from their inception by every one with any experience who read even their own documents with care, or who took the trouble to make inquiries about them. The inevitable losses which came to those who gambled in in these worthless chips have most unreasonably been charged to "mining" as an industry, and capitalists are warned, by citing these examples, of the dangers and losses in mining investments. It is scarcely saying too much to assert that the New York Consolidated Exchange has been a positive injury to the mining industry from the facilities which it has afforded for floating and dealing in worthless, if not absolutely fraudulent, enterprises and the disrepute which it has thus brought on mining shares as investment.

It is quite natural that its course should lead to a diminution in business in mining shares, as we have again and again stated it would, for even gamblers get tired of playing with chips only, and many valuable stocks, based on good properties and honestly managed, have not made application to be listed, preferring to gain a market value among their own stockholders to being in such bad company, and with the probability of suffering in market price for the sins of others.

The Committee on Mining Securities ignores this, the chief cause for the almost total lack of interest in mining investments on the exchange, and it endeavors to find the cause in the non-assessable feature of the New York law. Since, probably, the majority of the shares dealt in on the exchange are assessable this cause is not sufficient to account for the known facts.

The non-assessability of mining stocks undoubtedly has some serious disadvantages, and it is easy to cite many good properties, which have failed through insufficient working capital in the first place and inability to raise further means for carrying on the work; but on the other hand it is equally easy to cite many abuses and swindles perpetrated on stockholders through the assessability of their shares. No doubt it is possible to so guard the operation of each method as to avoid its chief dangers, and the Consolidated Exchange could do much good in this direction, but this is not the first step to take towards popularizing mining investments in New York. This step should be to vigorously exclude from dealings on the exchange all worthless and disreputable enterprises, and to take effective measures to prevent the introduction of any such in the future. This can be done, but it requires not only some honest purpose, of which the Exchange possesses a fair representation, but an amount of determination or "back bone" that is extremely scarce.

CORRESPONDENCE.

We invite correspondence upon matters of interest to the industries of mining and metallurgy. Communications should invariably be accompanied with the name and address of the writer. Initials only will be published when so requested.
All letters should be addressed to the MANAGING EDITOR.
We do not hold ourselves responsible for the opinions expressed by correspondents.

Buchanan Magnetic Separator.

EDITOR ENGINEERING AND MINING JOURNAL:

SIR: I am obliged to Mr. Hoagland for his free advertisement of my machinery, although I must confess that his conception of my ideas, as illustrated in your last issue, are not very creditable to me as a designer. The Buchanan crushing rolls he alludes to are the ordinary light rolls in common use, which I designed some ten years ago, and are *not patented.*

My new and improved rolls, for which patents are now being issued, as well as my new rock breaker, are made only by the Beckett Foundry and Machine Company, who are also the only builders of my magnetic separator under special license from the owner of the patents. Very truly yours,

C. G. BUCHANAN,
Consulting Engineer to The Beckett Foundry and Machine Company.

ARLINGTON, N. J., June 25th, 1889.

The Great Eastern Mining Company of Arizona.

EDITOR ENGINEERING AND MINING JOURNAL:

SIR: I notice that the Great Eastern Mining Company "offer a limited amount of stock for sale for development purposes." I wish to say in regard to this that "Wm. F. Wernse, Banker," is the same person who stocked and floated the great Queen of Sheba fraud on St. Louis about a year ago, and which I called attention to in the columns of the JOURNAL of March 3d, 1888. As far as the Great Eastern Mining and Milling Company is concerned, or its value as an investment, I have nothing to say, but would-be investors will do well to investigate anything that this St. Louis broker or "banker" places on the market. The "Queen of Sheba" property never had a trace of mineral on its ground, yet the stock was quoted up to 50 cents per share, when it finally ended its existence in the summer of 1889. It failed, however, to liquidate the debts that were contracted here during its brief life.

Mr. Wernse, however, continued to live, and immediately organized and floated another company in St. Louis. The folks there must like this kind of medicine, but if the gentleman calculates to extend his practice into other fields it is time some one called attention to it, and with your permission I take the liberty to do so.

Very truly yours. HARRINGTON BLAUVELT, M. E.

DE NOON, ARIZONA, Pinal P. O., June 16, 1889.

The Mexican Silver-Lead Ore Importation Question.

NEW YORK, June 22, 1889.

EDITOR ENGINEERING AND MINING JOURNAL:

SIR: If your correspondent "J. J. M." (whose communication is published in to-day's JOURNAL) will kindly take the trouble to re-read the letter which has apparently so roused his youthful impetuosity that he has become blinded to its real purport, he will perhaps discover that he has builded up a man of straw ostensibly for the fun of knocking it down again; or, to express the idea in his own language, he has been "taking ideal suppositions instead of practical facts for his 'hypothesis.'"

With this explanation I trust he will understand that the above mentioned letter deals simply with the question of the correctness of the present ruling in relation to the importation of lead ore, and does not enter the broader field of the politico-economical aspect of the case.

Kindly permit me, however, to add a few words more to the discussion of this interesting subject. Section 2502 of the Revised Statutes is as follows:

"There shall be levied, collected and paid upon all articles imported from foreign countries and mentioned in the schedules herein contained the rates of duty which are by the schedules respectively prescribed, namely: Schedule E., 188—Lead ore and lead dross, one and one-half cents per pound."

From this there can be but one reasonable inference or deduction, which is that *Congress intended that a duty should be paid on all lead ore imported from foreign countries;* for, otherwise, lead ore would have been put upon the free list. This much, at least, seems to be incontrovertible.

The only point that now remains to be determined is what did Congress mean by the term "lead ore?" Judging from the recent discussions on this point one might almost say, in the expressive language of the late "Lord Dundreary," "it is one of those things that no fellow can find out;" but Secretaries of the Treasury and the Judiciary Committee of the Senate, in endeavoring to fathom the depths of congressional intellects, have decided that a lead ore is not a lead ore when the money value of its silver contents is greater than that of its lead contents, though in other respects it possesses *all* the requirements of a lead ore and is used as such. This sort of reasoning is a counterpart of that used in the old saying, "a door is not a door when it is ajar," though in other respects it has all the requirements of a door, for it is a fact that the silver in a lead ore is the *door ajar* in our "protection" wall (according to the present ruling) that has permitted the free entry of more than 28,000 tons of dutiable lead in so-called "silver ore" in one year alone, an average of about 600 pounds of lead to each ton of "silver ore."

Now, Mr. Editor, in the absence of a specific congressional definition of the term "lead ore," is it not sound common sense to infer that the substance alluded to is what is universally known to be and is designated as "lead ore" by all who have dealings in that commodity? It may be termed an argentiferous lead ore, a silver-bearing lead ore (and, by contraction, a silver-lead ore), a high-grade lead ore, a low-grade lead ore, or whatever kind of a lead ore one may rightfully call it, but the fact remains that it is a lead ore, and particularly so for the purposes of the tariff.

It has been argued somewhat ingeniously, but less ingenuously, that the Mexican ore is smelted only for the silver it contains, and that the lead is consequently a by product; still, even this method of "whipping the devil round the stump" does not alter the real facts of the case.

There is, however, another and probably more important aspect of this matter. The strict enforcement of the *law* (not its present interpretation) means more or less loss not only to those who, relying on the sincerity and good faith of the government as indicated in the departmental decisions, have invested large amounts of capital and have built up very important industries, but also to the people at large, who have certainly profited by the commercial relations with Mexico, that are a result of these very industries, more than they have lost, and it is doubtful if they have lost at all.

Viewed in this light, it must be admitted that the treasury ruling has been a pronounced commercial success, as it has clearly demonstrated the desired ability of admitting at least our raw material free, and with this marked example as a basis it surely seems logical to argue that similar good results will certainly follow the free importation of other raw materials. E. M

NEW YORK, June 22, 1889.

GASTON PLANTÉ.

This distinguished French electrician, who died recently in Belleville, near Paris, was born in Orthez, France, on May 22, 1834. He was educated at the Conservatoire des Arts et Metiers, in Paris, and became an assistant in the laboratory of Edouard Becquerel, the well-known physicist, whose researches on light are so famous. Subsequently Planté entered the employ of Christofle as chemist, and there carried on his investigations on the nature of electrical polarization. He was throughout his life an indefatigable experimenter, and his chief work was his study of the voltameter, resulting in 1859 in the invention of the storage cell with lead plates. He experimented upon all conceivable metals and combinations of metals to be used for electrodes in voltameters, and the result of his numerous tests showed that lead is the best active material from a practical point of view, though the amount of energy which he found possible to store per unit of weight was greater in the case of some other metals. It was not the desire to find a storage battery that led Planté to undertake the long series of investigations, for at that time the application of dynamos to electric lighting was still unknown, but rather the desire to study the effects of electric discharges of great quantity, which were not attainable with frictional machines and Leyden jars.

He also invented what he called the "machine rheostatique," being essentially a commutator which, on being turned by a crank, rapidly changed the grouping of the secondary cells from parallel to series. Of late years Planté devoted himself almost exclusively to the reproduction of meteorological phenomena in the laboratory by electrical effects, and he succeeded in thus imitating hail, globular lightning, and similar effects.

He received the diplome d'honneur at the electrical exhibition held in Paris in 1881 and he contributed some interesting apparatus and specimens, illustrating his latest work, to the present exhibition. The Academy of Sciences gave him the Prix Lucaze, and the Society for the Encouragement of National Industries conferred on him its Ampère medal. He was made a chevalier of the Legion of Honor in 1881, and subsequently advanced to a higher grade in that body. The results of his investigations were communicated as separate papers to the Academy of Sciences, and these he issued in book form in 1879 as Recherches sur l'Electricité," and more recently he published "Phenomènes Electriciques de l'Atmosphere." Concerning the former, Gaston Tissandier, editor of *La Nature*, refers to it as an imperishable book, which deserves to be regarded as one of the greatest monuments ever raised to the science of electricity. He also adds that the name of Planté will be handed down to posterity with those of Volta and Ampère as among the immortal founders of the new science.

Although he carried on so many original investigations, Planté never troubled himself to secure patents, but freely gave to the world the results of his labors. His last act was proof, if that could be necessary, of the love he bore to his fellowman. The property at Bellevue is to be converted into a home for poor scientists; and in addition to this provision of his will, he instituted a prize of 3000 francs, to be awarded every other year for the discovery of some new fact or property of electricity.

GASTON PLANTÉ.

AMERICAN ENGINEERS ABROAD.

Our first day's work and pleasure after landing was Thursday, the 6th inst., when we had the opportunity of inspecting the Liverpool docks, Messrs. Laird's shipbuilding works at Birkenhead, and the Mersey Tunnel, and in the evening we were entertained hospitably by the Mayor.

On Friday morning we divided into two parties, and were conveyed by special trains, one to the Crewe Locomotive Works of the London & Northwestern Railway Company, and the other to the Horwich Locomotive Works of the Lancashire & Yorkshire Railway. The works at the latter place are new and very perfect in their arrangements, while those at Crewe are well known.

At Horwich the land enclosed for the works includes 85 acres, and the covered area of workshops is 13½ acres. The workshops comprise offices, general stores (with gallery), boiler-shop smithy, forge, steel-foundry, iron and chain foundries, boiler-house, brass-foundry, tin and copper smiths' shops, telegraph, millwrights', joiners' and pattern-makers' shops (with gallery), and pattern store; fitting, points and crossings, and signal shops; spring smithy, erecting shops, engine shed, paint shop, chain testing shop, and chain smithy. The carriage of materials from stores and work to their several shops is done by means of tramways, 18-inch gauge, of which there are five miles, the heavy work being drawn by small locomotive engines specially built for the purpose. At the close of the inspection, lunch was provided by the directors of the Lancashire & Yorkshire Railway Company.

In the evening we all met in Manchester, where we were received by the mayors of that city and of Salford, Oldham and Stockport, before dining in the City Hall at a banquet given by the Manchester Reception Committee of the Institution of Civil Engineers. On Saturday morning many of us inspected the Salford & Barton portion of the Manchester Ship Canal, and we were accompanied by Mr. W. Radford, Chairman, and Mr. T. Ashbury, Secretary of the Manchester Reception Committee; Mr. S. R. Platt, representing the directors of the Ship Canal Company; Mr. Leader Williams, engineer; Mr. Walker, contractor; Mr. E. H. Carbutt, of the Iron and Steel Institute; Mr. W. Goldthorpe, and other gentlemen. We were first shown over the dock works, which were fully explained by Mr. Williams, who, having spoken of the natural advantages to be obtained here, expressed the opinion that the docks would be the cheapest ever made. Leaving Salford, we were taken to Pomona, where we had an opportunity of seeing dock construction in the earlier stages. From Pomona the train passed on to Barton. Special attention was called to a long, deep cutting effected by a single excavator since Christmas. At Barton interest centered mainly upon the swing aqueduct scheme. The company had to deal with five lines of railway, which would be carried over at a very high level. The new railways would be completed, tested by the government authorities, and opened six months before they discharged the old lines. In the same way the old aqueduct at Barton would be retained until the new one was ready.

On the return to the Salford Docks, Dr. Emery, of Brooklyn, expressed our wish to record our thanks for our reception, and he called upon Mr. Hunt, of Pittsburg, to propose a resolution to that effect. Mr. Hunt said he knew he expressed the sentiments of every one of the American engineers in asserting that they had had an enjoyable and instructive morning. In fact, from an engineering point of view, it had been one of the events of their lives to see and learn all about the work upon the ship canal. Mr. Carbutt said the Manchester Ship Canal was the largest work that was going on in England at the present time. Mr. S. R. Platt, on behalf of the directors, said they knew they were going on in the right way, and the knowledge gave them great encouragement in their undertaking. They were very pleased to see the American engineers.

From Saturday, June 8th, to Wednesday, the 12th, the party dispersed themselves through England, visiting the lakes, North Wales, Derbyshire, Warwickshire, or whatever district attracted them. At 10 A. M. on Thursday we attended choral service in Westminster Abbey; at 11 A. M. we met in Henry VII.'s chapel to hear an address from the Dean, Dr. Bradley, on the sacred and historical associations of the Abbey; followed at noon by an inspection of the Houses of Parliament. A formal reception took place at 3 P. M. at the Institution of Civil Engineers, followed at 3:30 by the presentation of an address of welcome by the President, Sir John Coode, K. C. M. G.

Professor Thurston, in reply, cordially thanked the institution for the hospitality which the visitors were enjoying, exceeding, as it did, anything they could have imagined. They who had seen so much in the new world had come over to see what the later work in the old world had been. The occasion was truly memorable, and could not fail to become historical. For the first time they had the spectacle of a great body of members of all branches of the profession coming across the seas to meet their brethren, not only of Great Britain, but also of the whole world. He looked upon that meeting as an assurance that when engineers had advanced civilization a little further all Christendom would be more and more united in brotherly bonds, and legislatures would govern solely in accordance with the true interests of the people. On behalf of the whole profession in America, he tendered to the members of the institute the heartiest thanks for the hospitality of which they were the gratified and grateful recipients. The President mentioned that copies of the address would be sent to each of the four engineering institutes in America, and the proceedings terminated. In the evening we were entertained by the Institute of Civil Engineers at a banquet at the Guildhall, which was courteously lent by the Lord Mayor and other civic authorities for the occasion.

W.

THE PLATINUM METALS.

Platinum, palladium, rhodium, iridium, ruthenium and osmium form a group of metals that are usually found together, and are naturally allied to each other by common properties.

PLATINUM.—The most important member of the group is the one from which it takes its name. It is a little whiter than iron, it is exceedingly malleable and ductile, both hot and cold, and is very infusible, melting only before the oxyhydrogen blowpipe or in a powerful blast furnace. Its specific gravity is 21.5, and it is the heaviest substance

known. Neither air, moisture, nor the ordinary acids attack platinum in the slightest degree at any temperature; hence its great value in the construction of apparatus for use in chemistry. It is usually found in the form of small rounded and flattened grains.

Occurrence.—Platinum alloyed with other members of this group of elements is found in small quantities in the beach sands and gold placers of the Pacific Coast. It also is found associated with placer gold in Virginia, North Carolina, Georgia, and other Southern States. In California the principal places of its occurrence are at Hay Fork, a branch of the Trinity River; also on the North Fork of the Trinity; in Butte County, in the hydraulic mines around Cherokee and Oroville; in Mendocino County, in Anderson Valley, Novarro River; in Plumas County, on the principal forks of Nelson Creek and at Badger and Gopher hills; on the Salmon River, and in the bed of the larger streams in Sierra, Trinity, and Del Norte counties; on the beach between lakes Blanco and Mendocino; in the Merced and Tuolumne rivers Going farther north the amount of platinum increases, and in Oregon it is found near Waldo, Josephine County; near Port Orford and Eckley, Curry County; near Randolph, Coos County, and at McKenzie's Bridge, Lane County. It has also been reported at near Hailey, Idaho; on the Agua Frio, Anzoria, in Wyoming Territory, and in 1887 a nugget weighing 104·4 grains was described that was found near Plattsburg, N. Y.

The important discovery of a mineral containing platinum and arsenic was made in the autumn of 1888, at the Vermillion mine, near Sudbury, Ontario, Canada. It was named Sperrylite, and was found to contain upward of 7·52 per cent of platinum. This is of special interest as it is the first time that the element has been found as an important constituent of a mineral and its finding will doubtless lead to other similar discoveries in the United States. The impure platinum sands of the west have a value of 75 cents or more a troy ounce in San Francisco whence they are shipped to London.

Foreign Sources.—The greater part of the platinum that finds its way into commerce is derived from placer deposits in the districts of Soroblogodar and Nishni-Tagilsk in the Ural Mountains. Its refining is largely accomplished by the house of Johnson & Matthey, of London, where Deville's process is used, and the French corporation in Paris, formerly known as Quennessen, Le Brun and Desmoutis. It is from these two firms that most of the platinum imported into this country is purchased.

*Extraction.**—The method of mining is analogous to that of placer gold, with the exception that the apparatus for saving platinum depends upon gravity alone, and not upon gravity and amalgamation. From the material thus accumulated platinum is derived in the following method. The crude metal is acted upon as far as possible by nitro-hydrochloric acid containing an excess of hydrochloric acid and slightly diluted with water, in order to dissolve as small an amount of iridium as possible. To the deep yellowish-red and highly acid solution thus produced, ammonium or potassium chloride is added, by which nearly all of the platinum is precipitated as a platino-chloride of either potassium or ammonium. This substance, washed with a little cold water, dried and heated to redness, or reduced in a current of hydrogen, leaves metallic platinum in a spongy state. Platinum cannot be fused into a compact mass by ordinary furnace heat, but the same object is accomplished by welding it at a high temperature. The spongy platinum is made into a thin uniform paste with water, introduced into a slightly curved mould of brass and subjected to a gradual pressure, by which the water is squeezed out, and the mass rendered at length sufficiently solid to bear handling. It is then dried, very carefully heated to whiteness, and hammered or subjected to powerful pressure, when the platinum will be in a state to bear forging into a bar. The method of refining devised by the French chemists, Deville and Debray, consists in submitting the crude metal to the action of an intensely high temperature in a crucible of lime. The apparatus is as follows: The lower part of the furnace consists of a piece of lime hollowed out in the center to the depth of about one-quarter of an inch; a small notch is filed at one side of this basin, through which the metal is introduced and poured out. A cover made of another piece of lime fits on the top of this basin. It is also hollowed out to a small extent and has a conical perforation at the top, into which is inserted the nozzle of an oxy-hydrogen blowpipe. The whole arrangement is firmly bound with iron wire. To use the apparatus the stopcock supplying the hydrogen is opened and the gas lighted at the notch in the crucible. The oxygen is then gradually supplied, and when the furnace is sufficiently hot the metal is introduced in small pieces through the orifice. By this arrangement as much as 50 pounds of platinum and more may be fused at once. All the impurities in the platinum are separated in this way; the gold and palladium are volatilized, the sulphur, phosphorus, arsenic, and osmium oxidized and volatilized; and the iron and copper oxidized and absorbed by the lime of the crucible. The Siemens electrical furnace is readily adapted to its use. For some years the firm of Bishop & Co., Sugartown, Chester County, Pa., devoted considerable attention to the manufacture of platinum vessels, but within the last few years John Entriken, Baker & Co., Newark, N. J., and the Wilmington Dental Manufacturing Co., have introduced the manufacture of platinum wire in this country.

Uses.—The principal consumption of platinum has been in the manufacture of chemical apparatus. In the form of various utensils, such as evaporating dishes, crucibles, retorts, funnels, spatulas, combustion boats, blow-pipe tips, foil and wire, platinum is a necessary adjunct in the equipment of every chemical laboratory, on account of the high temperature at which it melts and its property of resisting acids. Large evaporating dishes and retorts of platinum are used in the manufacture of sulphuric acid, especially in such works where care is taken to produce an acid which contains no nitric acid. Platinum is also useful in making many instruments of precision, especially standard weights and measures. This metal was used in coinage by the Russian government, but after a few years it was withdrawn. Platinum is employed for pins in artificial teeth. Vessels of copper, brass, etc., may be plated with platinum by welding the platinum foil to the other metals. Dishes made in this way withstand the action of acids even when the coating is very thin, but they are apt to scale when heated highly. Tips of lightning rods are frequently plated with platinum. Finely-divided platinum is used as a lustre in porcelain painting. Reflecting surfaces on glass have been made quite a success with a thin coating of platinum. By polishing a surface of glass and using a coating on this for direct reflection, mirrors can be made even when the glass is somewhat imperfect, and these are used in certain physical instruments, as they have the property of transmitting just enough light to enable observations to be made conveniently through the mirror. The use of incandescent electric lights and gas jets made luminous by a heated platinum spiral have created an increased demand for the metal. It has also numerous other applications in connection with electric lighting. A process for coating metals with platinum was introduced in Paris in 1878 by M. Dodé, but the extension of the application has been rather limited.

Alloys of platinum and iridium and of platinum and silver have been found to be of value for the construction of standards of resistance in electrical measurements.

In 1882 the quantity of American platinum marketed was about 200 Troy ounces, which continued at the same figure in 1883, but diminished to 150 ounces in 1884. The reports of 1885 show a total production of 250 Troy ounces valued at $187.50. Owing to the difficulty of obtaining crude platinum from the Ural mines and the advance of price of the refined metal during the summer of 1887, search for the crude ore resulted in the placing in the market of 448 ounces of platinum that was sold in New York, Boston, San Francisco, and elsewhere for $1838, thus showing that an increased demand if sufficiently stimulated would be responded to During 1888 Dr. Day reports that, including the platinum and iridium separated from gold by the assay offices, and that saved in placer gold mining, the product was about 500 ounces, valued at $2,000.

Imports and Exports.—For the fiscal year ending June 30, 1882, there was imported unmanufactured platinum, such as wire or rod, and sheet or plate, to the value of $285,731, and manufactured platinum consisting of several large stills for rectification, worth $48,452, were imported. These amounts have steadily increased until, in 1888, 5,345 pounds of unmanufactured platinum valued at $565,459 were received, and $52,295 worth of manufactured platinum was entered. It is estimated that 40,000 ounces of platinum are annually consumed in the United States. The price of the unmanufactured platinum was $6 a Troy ounce in 1882, which increased in 1883 from $6.50 to $7.50, and in 1884 reached $8.50, but it then fell back to $7.50, at which price it remained until 1887, when it was quoted at $6.80. A certain amount of old or scrap platinum is annually exported to England and France. It varies in quantity according to various circumstances, and was $600 worth in 1880; $7000 worth in 1885, and $19,700 worth in 1887.

PALLADIUM.—This metal, which has but few uses, greatly resembles platinum in its properties. It is found with platinum and is separated from the other members of the group by neutralizing the acid solution (from which the platinum has been precipitated) with sodium carbonate and mixing with a solution of mercuric cyanide. Palladium cyanide separates out as a whitish, insoluble substance, which, on being washed, dried, and heated to redness, yields metallic palladium in a spongy state. Palladium forms alloys with various metals, such as copper and silver, the latter of which is used to some extent. An amalgam of palladium is employed by dentists in filling teeth. There has recently been described in Dingler's an alloy consisting of from 60 to 75 parts of palladium, 15 to 25 parts of copper, and of 1 to 5 parts of iron, and its use recommended as suitable for the manufacture of watches owing to its non-magnetizable qualities. It is prepared by mixing half the palladium with the remaining metals, fusing the mixture with borax and powdered charcoal, adding the remainder of the palladium, again fusing and pouring the remainder into suitable molds. Other palladium alloys were described containing varying proportions of silver, gold, platinum and nickel.

RHODIUM.—In common with the other metals of this group, it is found alloyed with platinum in placer deposits. From time to time it has been reported that rhodium occurs in small quantity in the amygdaloid rocks of Keweenaw Point, Lake Superior; but we believe that its presence has not been authoritatively established. This metal remains in the solution after the platinum and palladium have been removed, and is separated in the following manner: The solution is mixed with hydrochloric acid and evaporated to dryness, when the residue is treated with alcohol of 0·837 density, which dissolves everything except the double chloride of rhodium and sodium. This is well washed with alcohol, dried, heated to whiteness, and then boiled with water, by means of which the sodium chloride is dissolved out, and metallic rhodium remains. It is a white, coherent, spongy mass, still less fusible and less capable of being welded than platinum. Its only application is as an alloy, and a small quantity of it in steel is said to impart most valuable qualities.

IRIDIUM.—Second in importance of the members of this group is iridium, which is a white metal, resembling polished steel, brittle in the cold, somewhat malleable at a red heat and having a specific gravity equal to that of platinum. It is almost infusible in the flame of the oxyhydrogen blow-pipe, but has been fused by the heat of the electric arc, and can be welded at a white heat.

Occurrence.—Besides being found alloyed with platinum, its principal source is the mineral iridosmine, which in this country is found chiefly in the placer washings of California and Oregon, where it accumulates with the gold on account of its weight and is easily recovered and saved. The chief commercial source of the mineral is in the placer deposits of the Ural Mountains, Russia, but it occurs also in Brazil, East India, Borneo, Canada and Australia, and in small quantities in France, Germany, and Spain.

Extraction.—When the crude platinum is dissolved in nitro-hydrochloric acid, a small quantity of a gray scaly metallic substance usually remains behind, having altogether resisted the action of the acid. This is the native alloy of iridium and osmium. Its reduction has always been a matter of great difficulty, on account of its infusibility and insolubility, which was further increased by the presence of osmium, which in the form of osmic acid is probably the most poisonous substance known. Various treatments were in practice, and the subject was one that was receiving considerable attention in the laboratories of Europe, notably those in Paris, when it was found in Cincinnati that, by heating iridium or any of its ores in a sand crucible to a white heat, and then adding phosphorus, the latter rapidly combined with the iridium, and in a few seconds the contents of the crucible were in a perfect state of fusion,

*See this JOURNAL for Oct. 8, 1887.

capable of being poured and cast into an ingot. This material proved to be as hard as iridium, and seemed to have all the properties of the metal itself.

Uses.—Iridium prior to the discovery of a convenient means for its fusion had no practical applications save as alloyed with platinum, and in this connection the standard meter in Paris was made of an alloy consisting of 90 parts platinum and 10 parts iridium. Since then it has been used by the American Iridium Company, of Cincinnati, for the so-called diamond points upon gold pens, for the points of stylographic pens, for the knife edges of fine balances, for the tips of rubber turning tools, for wire draw-plates in electric lighting, for the electric contact points of telegraphic apparatus, and, indeed, for any purposes where an exceedingly hard metal is required. Prof. William L. Dudley, now of Vanderbilt University, succeeded in enlarging its application by depositing it electrolytically on base metals, and found that such a deposit was exceedingly tough and susceptible of a high polish. The sesquioxide of iridium has been used in porcelain painting to produce fine blacks and grays.

Production.—It was estimated in 1884 that at the mint in San Francisco there were annually accumulated from 150 to 300 ounces of iridosmine. This as it came from the mines having been thoroughly washed and freed from "black sand" was then valued at from $2 to $5 an ounce. Fused iridium was worth $10 an ounce, and refined iridium entirely imported from abroad was valued at $20 an ounce. In 1885 the demand for the iridosmine was placed at 300 ounces and the same amount was reported for 1886. The imports have not been carefully reported, and in 1885 $5,852 worth of iridium was noted as having been imported; no returns have been made since as none of importance has been entered.

RUTHENIUM.—The source of this metal is platinum ore, chiefly that variety known as osmiridium, which consists principally of osmium, iridium and ruthenium. To obtain ruthenium, scaly osmiridium is heated to bright redness in a porcelain tube, through which a current of air (freed from carbonic acid and from organic matter) is drawn by means of an aspirator. The osmium and ruthenium are thereby oxidized, the former being carried forward as tetroxide and condensed in solution of potassium hydroxide, while the ruthenium oxide remains behind, together with iridium, and by fusing this residue with potassium hydroxide, treating the mass with water and leaving the liquid in a corked bottle for about two hours to clarify, an orange colored solution of potassium ruthenate is obtained, which, when neutralized with nitric acid, deposits velvet-black ruthenium sesquioxide, and this, when washed, dried and ignited in hydrogen, yields the metal. Ruthenium thus prepared forms porous lumps very much like iridium, and is moderately easy to pulverize. It is the most refractory of all metals except osmium. It is not used in the arts.

OSMIUM.—The final member of this group is found chiefly in the iridosmine, and it is separated from the other elements with which it is associated by its ready oxidation with nitric or nitro-hydrochloric acids, or by ignition in air or oxygen, and the volatility of the oxide thus produced. Metallic osmium is prepared as follows: When ruthenium and osmium are oxidized, the latter as tetroxide is passed in the form of a vapor into a solution of potassium hydroxide. This solution is mixed with an excess of hydrochloric acid and digested with mercury in a well-closed bottle at 40° C. The osmium is then reduced by the mercury and an amalgam is formed, which, when distilled in a stream of hydrogen till all the mercury and calomel are expelled, leaves the metallic osmium in the form of a powder. In this state it is black, destitute of metallic lustre, which it acquires by burnishing; in the compact state it exhibits metallic lustre and has a specific gravity of 10. Deville and Debray, by igniting precipitated osmium sulphide in a crucible of gas coke, at the melting heat of nickel, obtaining it in bluish black, easily divisible lumps. When heated to the melting point of rhodium it becomes more compact and acquires a density of 21·3 to 21·4. At a still higher temperature, capable of melting ruthenium and iridium, and volatilizing platinum, osmium likewise volatilizes but still does not melt. It is the most refractory of all metals. The tetroxide of osmium or osmic acid, as it is more frequently called, is sometimes used in microscopy. This is its only application as far as we know. Its fumes are exceedingly poisonous and it is estimated that the osmic acid produced in the preparation of the iridium for the standard meter was sufficient to kill the whole population of the globe.

THE NEW DRESSING-WORKS OF THE ST. JOSEPH LEAD COMPANY, AT BONNE TERRE, MISSOURI.*

(*Continued from page 569.*)

THE PARSONS FEEDER.

A simple and effective device, shown on plates IV. and V., is used to subdivide the sands or slimes, elevated by a single pump, among a number of machines, jigs or table. A satisfactory method of doing this, so as to secure an equal and uniform distribution, without any concentration or classification of the sands on one machine at the expense of the others, has been for a long time a great desideratum in dressing works. The ingenuity of Mr. Parsons has furnished a very satisfactory solution of this difficult problem. The feeder or distributor is a casting at the top of the pipe from the centrifugal pump, divided by partitions into a number of radial boxes, which surround the delivery pipe and are connected therewith by vertical slots of uniform size. By increasing the number of radial partitions the streams of sand or slime can be subdivided to any desired extent. From the bottom of each of these boxes a pipe conveys the sand or slime to the jig or table.

When it is necessary to shut off the supply temporarily from one jig or table, its box in the distributor is filled and the opening closed with a piece of cloth, which, for convenience in handling, is fastened to an iron rod with a loop-shaped handle. The distributors are made of cast iron, and are quite durable. Those now in use have required no repairs since the mill was built, 4½ years ago. The pipes leading from the distributors to the jigs must be renewed occasionally.

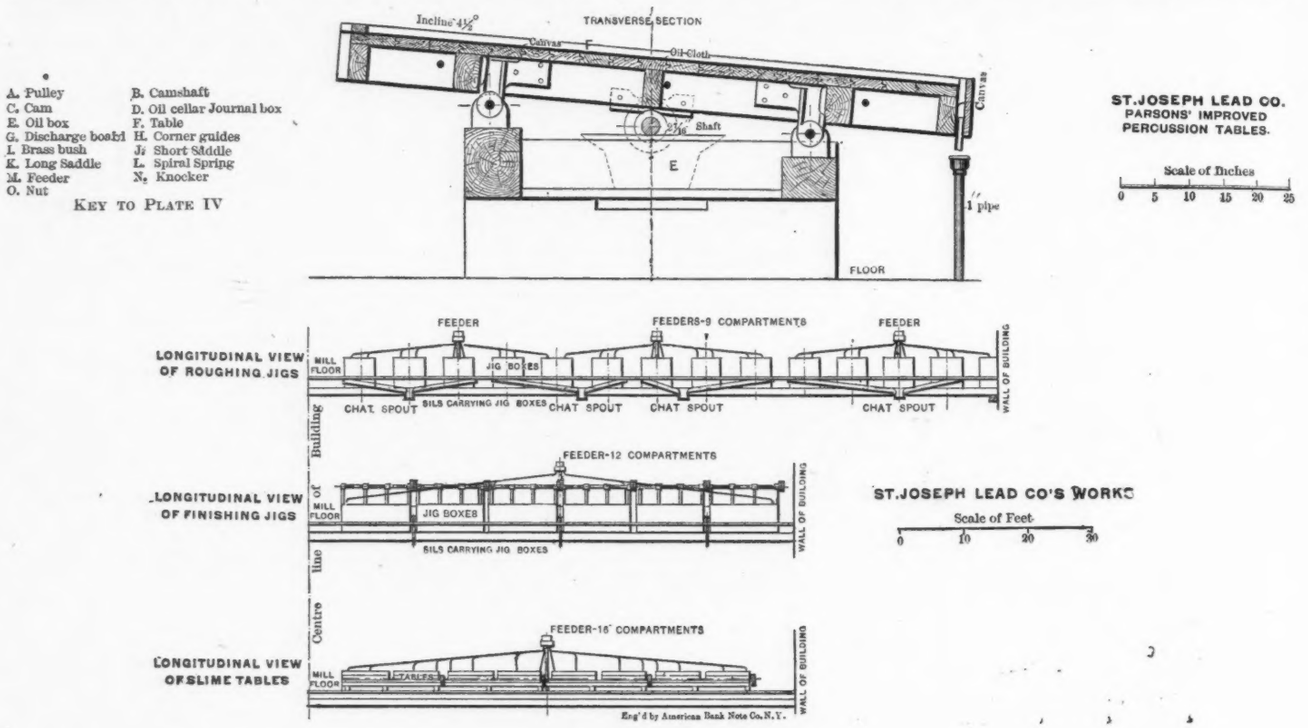
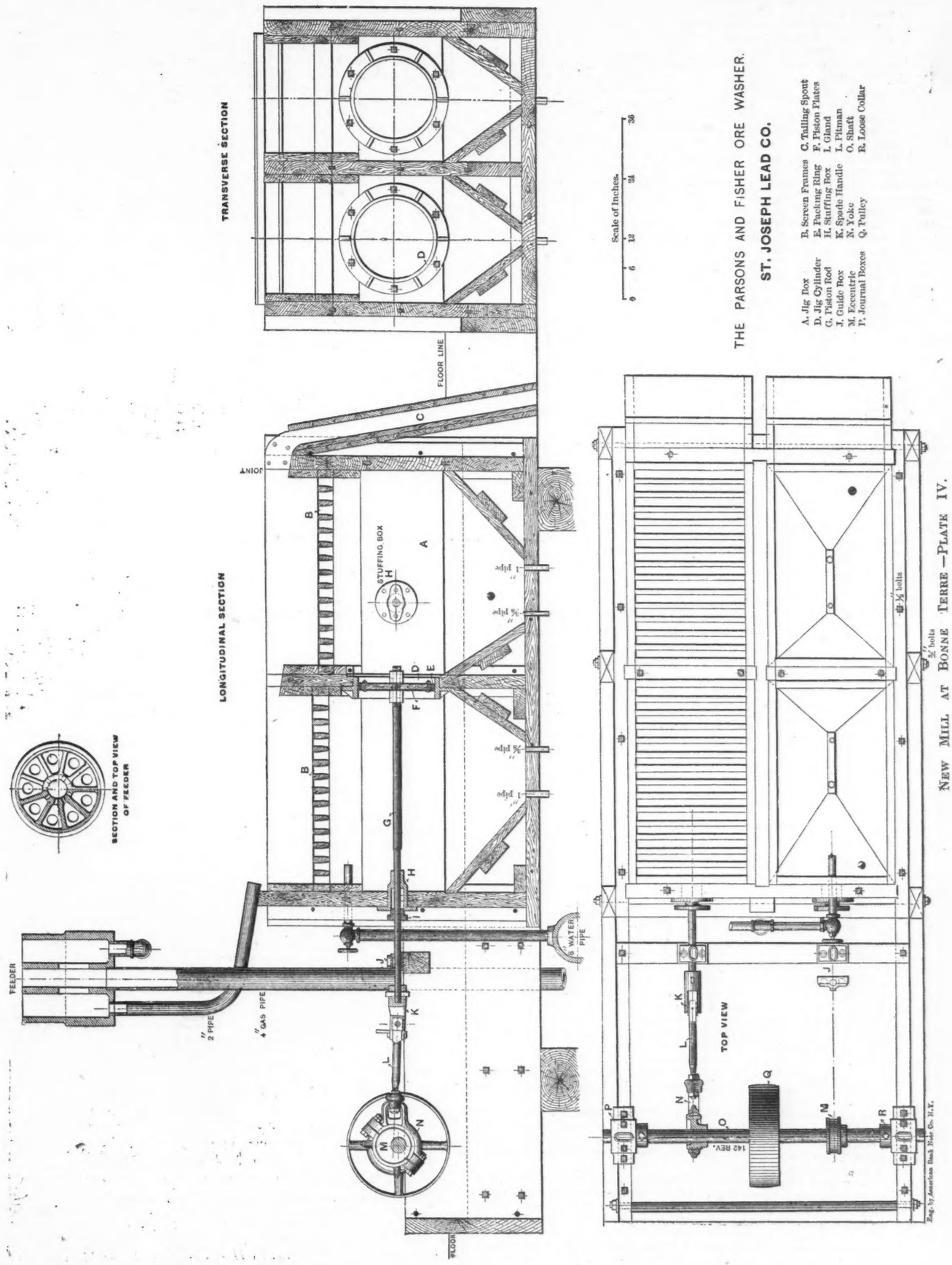


PLATE II.—PART 2.

ROUGHING JIGS.

Plate IV. shows the details of the Parsons jig, used for the preliminary jigging. It is a two-sieve under-piston jig, each sieve 24 inches by 39 inches (or 22 by 27 inches in the clear). The piston is vertical, 15½ inches in diameter, and moves in a short horizontal cylinder, 4½ inches long in the partition between the two jig boxes. The piston-rod is horizontal and enters through the stuffing-box. For convenience the jigs are made double, *i. e.*, four sieves or two jigs, are united in one machine. One great advantage of this form of jig is the small floor space occupied by a large number of machines, the whole area of the jig-box being available for jigging. The stroke of the piston is two inches, and the number of strokes per minute one hundred and fifty. The quantity of under-water required is about two cubic feet or 16 gallons per minute. The consumption of feed-water is 16 to 18 gallons per minute, containing about 13 pounds of sand (dry weight). There are nine jigs, 4½ machines, for each set of crushing apparatus. Each jig

* Paper by Prof. H. S. Munroe Transactions of the American Institute of Mining Engineers.



NEW MILL AT BONNE TERRE—PLATE IV.

treats, therefore, about 9 tons per 24 hours, or less than one-third the capacity of a jig of equal area according to data given by Rittinger, so that the mill has ample jig capacity.

In the Lake Superior copper mills the tendency, of late years, has been to increase largely the number of jigs, in the attempt to lessen the losses in the tailings. The St. Joe mill has, however, a larger jig capacity, in proportion to the rock crushed, than any of the Lake Superior mills. For the treatment of 800 tons of material per 24 hours there are 252 jig-sieves. The best equipped mill in the Lake Superior region would have on the same basis but 224 sieves. The rough sands at the St. Joe mill are divided between 90 sieves, or 9 tons per 24 hours to each. In the Lake Superior mill alluded to there would be but 60 sieves for the same mill capacity. At Lake Superior, however, about 45 per cent of the ore is separated in the classifiers as slime, and goes directly to the tables. This reduces the average amount of sand treated on each jig to 7½ tons per 24 hours. On the other hand, the sands are very unequally divided, so that some of the jigs treat over 10 tons per 24 hours, and others as little as 5 tons. These latter jigs treat very fine stuff, and at 5 tons per 24 hours are really worked to their full capacity. The loss on these jigs is fully as large as on the coarse jigs, notwithstanding the greater fineness of the material, and the smaller quantity of included copper present.

Experiments made by the writer, about two years ago, at one of the Lake Superior mills, seemed to indicate that the capacity of the mill could be increased fully 50 per cent, and this without increasing the losses, simply by making but two grades of sand in the classifiers instead of four. The practice at the St. Joe mill, when no attempt is made to classify the material before jigging, and when, consequently, sands and slimes are treated together on the same jigs, represents a further and extreme step in the same direction. The results obtained by this novel procedure are opposed to our preconceived ideas and accepted theories on the subject of jigging, and the St. Joe practice is certain to have important influence in modifying jigging methods in the future. The results obtained, it is true, are not wholly satisfactory, the loss of galena in the very finest slimes being large. In other respects, however, the method has many advantages, and the loss in the fine stuff can be brought within reasonable limits by simple modifications in the methods of treatment, which will be discussed further on.

During the past year the writer has had the opportunity of studying very carefully the working of these jigs. A large number of samples were taken, and several hundred assays made under his direction. In order to determine the action of the jigs on the coarse and fine grades of sand and slime, samples of the material treated, of the tailings, and of the hutchwork, were subdivided by sifting, and the different portions assayed separately. From the results of the sifting and from other data, it was possible to estimate the proportion of sand and slime of different grades passing through the jig-sieves into the hutchwork, and the proportion of each size which passed over the sieve and into the tailings under different conditions.

The following table contains typical assays of the material treated, and of the products of jigging:

SIZE.	Percentage of sand of each size.	Lead in ore. Per cent.	Lead in hutchwork. Per cent.	Lead in raggings. Per cent.	Lead in tails. Per cent.
1 mm. to 6 mm....	41·1	6·32	....	16·20	1·06
¼ mm. to 1 mm...	29·6	9·10	74·0	7·97	·96
⅛ mm. to ¼ mm..	9·3	13·81	19·2	....	·71
1/16 mm. to ⅛ mm..	1·5	12·93	14·8	....	1·09
1/20 mm. to 1/32 mm.	2·2	7·84	8·8	....	1·74
Below 1/20 mm.....	16·3	12·22	16·4	....	6·07
Average.....	100·0	8·93	22·3	16·54	1·53

From the assays of the different portions of the ore it will be seen that the stuff less than ¼ millimeter is richer than the average, while the portions coarser than ¼ millimeter are poorer. This is due to the friability of the galena, which is crushed finer than the gangue.

The hutchwork is quite poor, containing but 22.3 per cent of lead. This is due to the large proportion of partially concentrated fine stuff, less than 8 millimeter, about two-thirds of which passes into the hutchwork. This fine stuff is separated by the trunking-machine and the pointed boxes, and concentrated on the finishing-jigs and tables.

The assays of the several portions of the jig-tailings show very closely the limits within which the jigs are doing good work. It will be seen that the amount of lead in the tailings decreases with the fineness of the sands down to ¼ millimeter. A careful examination of these coarser sands will fail to show any free mineral, the lead being present as included galena. The finer the comminution the smaller the amount of such included mineral, and consequently the poorer the sands. Below ¼ millimeter the tailings increase in richness, which is due to the presence of free galena. The loss from this cause is not serious, save in the portion fluer than 1/20 millimeter.

It will be seen that the plan of jigging sands and slimes together makes it possible to treat very much finer material with success than has heretofore been supposed possible. The limit for successful work on jigs is generally placed at about 1 millimeter. The successful jigging of stuff ½ millimeter and less, marks a decided advance in the art of dressing. The coarse grains form the interstitial channels* in which this very fine stuff can be concentrated. It is well known that any attempt to treat stuff finer than 1 millimeter by itself results in a very imperfect working of the jigs, the losses being large, and the capacity of the jigs small.

The great advantage of this system of jigging is the large proportion of sands successfully treated and finally disposed of by the roughing-jigs alone. Out of 800 tons per day, only 136 tons require further treatment, viz., 30 tons raggings, crushed and treated on the three-sieve jigs, 66 tons fine sand, also treated on three-sieve jigs, and 40 tons of slimes treated on the side-bump tables.

The sole disadvantage lies in the difficulty of forcing all the very finest slimes to go through the jig-sieves. Under normal conditions about 40 per cent. of the stuff below 1/20 millimeter passes off with the tailings. Even this very fine stuff is somewhat impoverished by the action of the jigs, and of that which escapes, a very large proportion is too fine to be saved by any form of apparatus, so that the final loss from this cause is not as serious as might at first appear.

The jigs are run with a long stroke, and with as little feed-water and under water as possible, in order to carry the larger proportion of the fine stuff through the jig sieve.

It is possible, by lessening the amount of feed-water and under-water, to cause a larger proportion of this fine stuff to pass through the jig sieve, but at the expense of forcing through, at the same time, much coarser material, and thus sending to the finishing jigs material that can be treated successfully on the roughing jigs. The following table shows the effect of reducing the amount of water used in jigging, the percentages of hutchwork and tailings with the normal and with reduced quantities of feed-water and under-water being placed side by side for different sizes:

	Above ¼ mm.		⅛ to ¼ mm.		1/20 to ⅛ mm.		Below 1/20 mm	
	Normal.	Reduced.	Normal.	Reduced.	Normal.	Reduced.	Normal.	Reduced.
Hutchwork....	26	39	68	94	67	93	60	83
Tailings.....	74	61	32	6	33	7	40	17
	100	100	100	100	100	100	100	100

It will be seen that in each case the maximum percentages of sand pass through the sieve between 1/20 and ⅛ millimeter, and between ⅛ and ¼ millimeter. This indicates that the grain of maximum velocity is about ⅛ millimeter in size. This agrees closely with the size called for by theory. The theoretical limit† of successful work on these jigs is therefore about 1/16 millimeter.

It would be possible to classify the sands before jigging, and to send all this fine stuff directly to the tables. This would necessitate the use of a large volume of water to effect the classification, and would involve a large increase in the number of slime tables.

Experiments are now being made with every prospect of success, to reduce the loss in this very fine material, without sacrificing the advantages of the present method of treatment.

SPITZKASTEN.

The hutchwork of the roughing-jigs goes through a series of spitzkasten, respectively 1½ by 7½ feet, 4 by 6½ feet, 8 by 12 feet, and 8 by 12 feet in horizontal cross-section, and 2 feet, 7 feet and 10 feet deep. These boxes are built between the posts supporting the main floor of the mill. Their position is indicated in Plates I. and II.

TRUNKING MACHINE.

The material settling in the first box goes to the trunking-machine. This machine consits of a semi-cylindrical iron trough, in which revolves a screw conveyer. The trough is divided into two sections, respectively 14 feet and 10 feet in length. The screw conveyer in the lower and longer section is made up of a fan-shaped blades of cast-iron, about 4½ inches wide, with a space of about 2 inches between them, breaking the continuity of the screw. The material to be treated flows through rubber hose from the settling-box into this trough, being introduced about midway. The revolution of the shaft forces the galena toward the upper end. The water flows out at the lower end of the trough, carrying with it all the light sand. Wash-water is admitted through a line of spigots at the side of the trough. The upper section of the trough simply serves to convey the galena into the car.

Mineral coarser than ¼ millimeter or ⅜ milllimeter is very perfectly concentrated by this machine, and delivered to the car as nearly pure galena. Mineral finer than ¼ millimeter is carried off in the tails. The tailings from this machine are united with the product of the second box of the spitzkasten and go to the three-sieve finishing-jigs.

FINISHING-JIGS.

The three-sieve Hartz jigs used as finishing-jigs, as well as for the treatment of the crushed raggings, are of the ordinary side-piston type, and are not figured. They do not require special description. They are run at a speed of 270 strokes per minute; strokes ¼ inch in length. The jigs treating crushed raggings are run slower, 210 strokes, ⅜ inch long, per minute. The jig-sieves are of No. 8 wire cloth (No. 17 wire).

The following table gives the results of typical assays on samples subdivided by sifting:

SIZE.	Per cent of sand of given size.	Lead in sands treated. Per cent.	Lead in hutchwork.			Lead in tailings. Per cent.
			1st sieve. Per cent.	2d sieve. Per cent.	3d sieve. Per cent.	
Above ¼ mm.....	8·9	40·99	79·69	70·34	41·80	3·94
⅛ mm. to ¼ mm..	43·6	16·76				1·02
1/20 mm. to ⅛ mm.	13·3	16·40				·62
Below 1/20 mm.....	34·2	32·58				11·97
Average.....	100·0	24·75	Average, three sieves, 74·00.			5·24

The material on the finishing-jigs is very rich, containing about 25 per cent of lead, and the losses are quite large. The material treated is also very fine, over 90 per cent being less than ¼ millimetres. The losses are confined to the stuff below 1/20 millimetres, above that limit the tailings are poor, with the exception of the stuff above ¼ millimetres, the quantity of which is small (about 3 per cent of the tail). It will be seen that these jigs treat successfully finer stuff than the roughing-jigs, probably because of the finer jig-cloth and smaller interstitial channels. It is

* "Movement of Solid Bodies in Water," "Theory of Jigging," by the writer. See *School of Mines Quarterly*, Vol. IX., Nos. 2 and 3.

† *Loc. cit.*

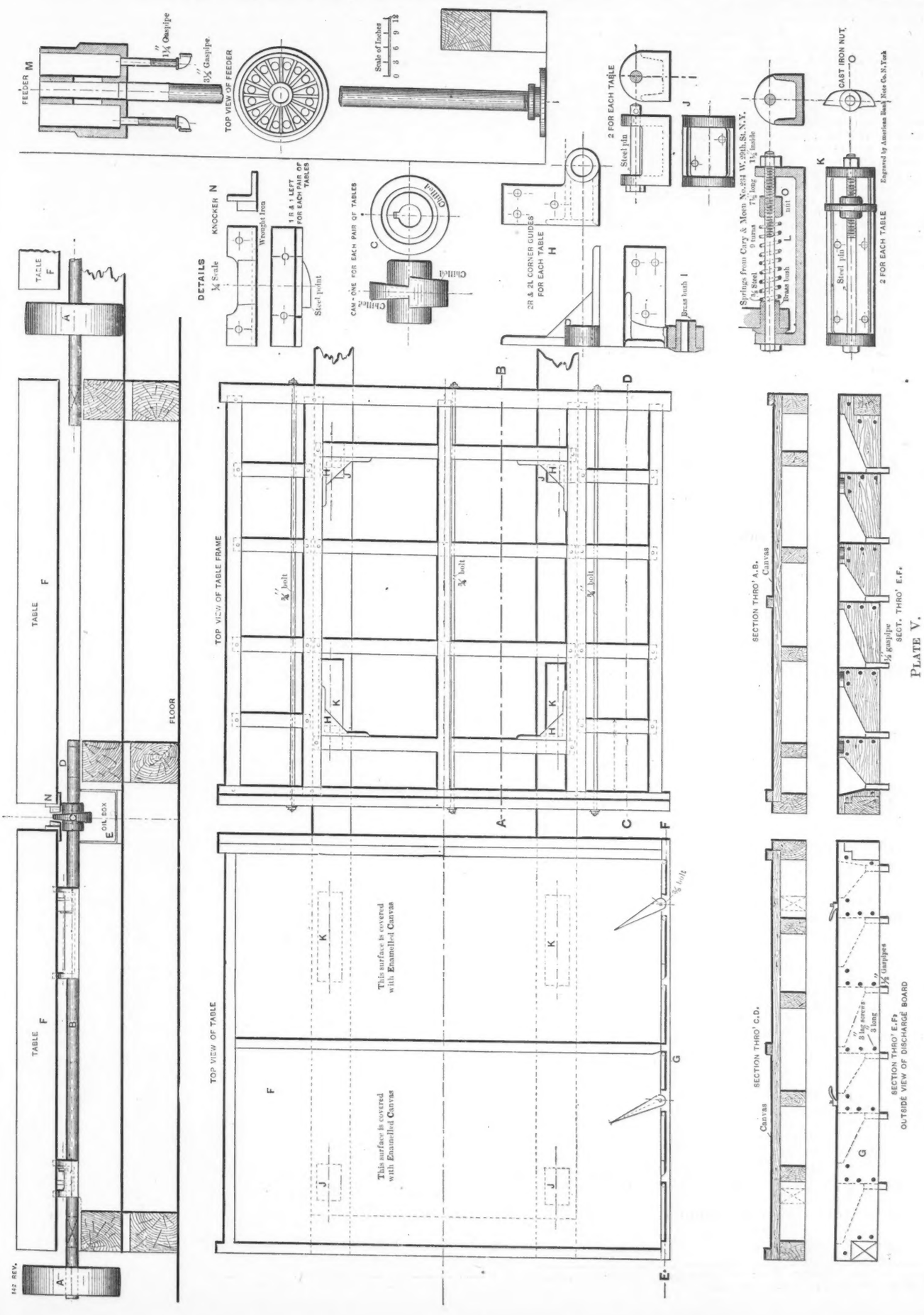

FEEDER M
1¼" Gaspipe
3/8" Gaspipe
TOP VIEW OF FEEDER
Scale of Inches
0 3 6 9 12
2 FOR EACH TABLE
Steel pin
J
CAST IRON NUT
O
Springs from Cary & Moen No. 234 W. 29th St. N.Y.
1½ inside
7½ long
Steel
Brass bush
L
K
Steel pin
2 FOR EACH TABLE
Engraved by American Bank Note Co. N. York
DETAILS
¼ Scale
KNOCKER N
Wrought Iron
1 R & 1 LEFT FOR EACH PAIR OF TABLES
Steel point
CAM ONE FOR EACH PAIR OF TABLES
C
Chilled
Chilled
2R & 2L CORNER GUIDES FOR EACH TABLE
H
Brass bush I
TABLE F
A
TABLE F
FLOOR
D
N
E OIL BOX
TABLE F
B
A
142 REV.
TOP VIEW OF TABLE FRAME
B
D
H
J
¾" bolt
K
A
C
F
TOP VIEW OF TABLE
This surface is covered with Enamelled Canvas
This surface is covered with Enamelled Canvas
¾" bolt
G
E
SECTION THRO' A.B.
Canvas
SECT. THRO' E.F.
½ gaspipe
SECTION THRO' C.D.
Canvas
SECTION THRO' E.F.
OUTSIDE VIEW OF DISCHARGE BOARD
8 lag screws
3 long

PLATE V.

proposed to treat the tailings of these jigs, or, at least, the finer portions of the tails, on round or side-bump tables.

PARSONS-RITTINGER TABLES.

The Rittinger side-bump table, as modified by Mr. Parsons, is shown in detail on Plate V. The tables are built in pairs, and each table is made double as usual. They are small, each half the double table being about 3 feet by 7½ feet. Instead of being hung from rods the table is supported on four cast-iron feet or "guides," which slide on horizontal steel rods. The latter rest in cast-iron "saddles," bolted to the heavy sill-timbers which run under the whole row of tables. Light spiral steel springs around two of these rods give motion to the table. The tables bump against each other, the blow being taken by joist of hard wood lying loose between them (not shown in the drawing). The tables are forced apart, against the tension of the springs, by a spiral wedge-shaped can; 160 bumps, ⅝ inch long, are given per minute.

The surface of the table is covered with the black enameled duck, sometimes used for desks. This covering is cheap and easily renewed, and furnishes a surface well adapted for the exceedingly fine material treated. The tables are inclined 4½ degrees. There are 16 pairs of double tables in the mill, or 64 tables in all. Of these, 32 are head tables and 32 are used for treating middlings. They are not worked to their full capacity, the head tables treating but 1¼ tons each, or 2½ tons to the double tables per twenty-four hours. The material treated is excedingly fine, 70 per cent being less than $\frac{1}{10}$ millimetre.

The following are typical assays of the stuff treated and the resulting tailings. The samples, as before, were subdivided by sifting.

	Percentage of sand of given size.	Percentage of lead in stuff treated.	Percentage of lead in tailings.
⅛ mm. to ¼ mm	9·0	2·50	·82
1-20 mm. to ⅛ mm	19·4	2·65	·40
Below 1-20 mm	71·6	15·52	2·74
Average	100·0	11·75	2·45

LOSS IN DRESSING.

For the year ending May 1st, 1887, the yield of the ore treated was 5·65 per cent. The loss in the tailings is about 2·13 per cent, or 27·4 pe cent of the total amount of lead in the ore. The losses in the Lake Superior copper mills range from 28·5 per cent to 31 per cent, treating material much more easily saved than this galena. The losses in each case are due to included mineral in the coarser sands, and to finely divided mineral in the very fine slimes. At Bonne Terre an unusually large part of the mineral exists in the ore in an exceedingly fine state of division, as is shown by the large percentage of included mineral in stuff as fine as $\frac{1}{20}$, ⅛ and ¼ millimetre. This necessitates very fine crushing, and consequently involves the production of a large amount of very fine stuff, much of which contains galena too fine to be saved.

COST OF DRESSING.

The cost of dressing for the fiscal year ending May 1st, 1887, was 36.4 cents per ton, divided as follows:

Labor	13.4
Repairs	10.0
Supplies	3.5
Coal	9.5
	36.4

This compares favorably with the very best Lake Superior practice, the cost of dressing at the Atlantic mill for the last few years being per ton of rock:

	Cents.
1881	42.54
1882	37.07
1883	35.35
1884	38.95
1885	30.36
1886	26.5
1887	27.5

The cost at the Atlantic mill (for 1885) can be subdivided as follows:

	Cents.
Labor	10.86
Fuel	14.52
Supplies, etc	4.98
	30.36

At the Atlantic mill the water is supplied through a launder above the level of the mill floor and is not pumped. The ore also is delivered to the mill at a higher level than at St. Joseph, and need not be elevated in the mill. This rock has also been previously crushed by jaw-crushers at the rock house, the cost of which crushing properly belongs to the cost of dressing, but is not included in the published figures. Finally, the sands are carried off with the water in the waste launders, and do not have to be loaded into cars. At least 10 cents per ton, therefore, should be added to the Atlantic mill figures in making comparisons of cost at the two places.

The amount of rock treated per ton of coal consumed is as follows:

St. Joseph mill, 1887	33·59 tons.
Atlantic mill, 1886	28.34 tons.

The advantage in favor of the St. Joseph mills would be even more striking if an allowance were made for the fuel consumed in elevating water and ore.

The limestone crushed at St. Joseph is probably not as hard as the amygdaloid rock treated at the Atlantic mill. Somewhat finer screens are used at the Atlantic mill, but the average fineness of the ore is almost exactly the same.

	1887. St. Joseph Mill. Rolls.	1886. Atlantic Mill. Stamps.
Above 1 mm	43·0	41·6
¼ to 1 mm	27·0	27·6
Below ¼ mm	30·0	30·8
	100·0	100·0

These figures indicate that it is cheaper to crush by rolls than by steam-stamps, and that the rolls produce quite as large a proportion of slimes as the stamps. The cheapness of the crushing and the large amount of slime, however, are both due in part to the friability of the ore.

It will be difficult to find two mills, either in this country or abroad, treating ore at equally low cost, and the above figures furnish a powerful argument for the English method of concentrating without size classification.

The losses in the treatment of the very fine stuff are large both at Lake Superior and in Missouri. The remedy in each case will doubtless be found in better methods of crushing and in extending and perfecting the slime-treatment.

THE PITTSBURG IRON WORKERS' WAGES SCALE.

The Pittsburg scale of prices, governing wages in rolling mills and nail factories for the year ending June 30th, 1890, was sent to all manufacturers by the Amalgamated Association on the 26th. This scale introduces but one new feature—the journeymen roll turners' scale—and in no place are any advances asked, while a number of concessions have been made.

At Jones & Laughlin, Oliver Bros. & Philips, Moorhead, McCleane & Co., A. M. Byers & Co. and J. Painter & Sons, it is stated that the scale is satisfactory, and will be signed by each firm individually. An analysis of the scale shows that in the memorandum of agreement the clause in former scales, relative to separate contracts to be made between rollers and heaters, in specialty mills, has been omitted. Boiling is fixed at $5 50 per ton on a 2-cent clear iron card. A new extra has been inserted, which fixes the price for busheling on cinder bottom at one-half the price paid for boiling. The muck and puddle mill scale is unchanged, and the price for scrapping and busheling reaffirmed at $2. There are some extras on this scale, viz.: Busheling on sand bottoms is to be paid for at the rate of 50 cents per ton (instead of 10 per cent above the correct price for piles on boards).

Rolling and Heating.

Knobbling is rated at $4.70 per ton for scrap and $6.11 for refined iron. Heating slabs and shingling is put at 75 cents for shingling muck. The price for rolling and heating on bar and nail plate mills is continued at 7 cents. The guide, 10-inch, hoop and cotton tie mills scales are unchanged.

A considerable reduction is agreed upon for the plate and tank mills. Under the old scale the roller received 80 cents per ton of common iron on a 2-cent card; by the new scale he will receive but 72 cents. The heaters' wages are, however, not altered. A number of extras are added, as: Nos. 10 and 11 gauges, 20 cents per ton above common prices. The price for rolling pipe iron in sheet and jobbing mills is reaffirmed, as is the sheet mill scale. In the list of extras under the latter, the following clauses have been added:

"Heater to receive one-fourth above prices, and 3 cents per bundle extra, to be paid by the company, for all iron No. 20 and lighter, annealed in an open furnace; shearman, one-fifth; roller to receive balance, and pay rougher and catcher only.

"When sheets are rolled lighter than the gauge they represent the mean between that and the next lighter gauge to be taken for the rolling price."

The sheet mill hands scale is unaltered. As a consequence of the fight of the roughers and catchers for a radical change in their scale, the agreement has been altered to read as follows:

Roughers and Catchers.

"It is understood that the roughers and catchers on sheet and jobbing mills shall each be paid as follows, based on a 2-cent Western Iron Association card, with 2 per cent additional for each $\frac{1}{10}$ advance of said card, and 2 per cent decline for each deduction of from said card, but it shall not go below a 2 cent card.

"On large sheet and jobbing mills the wages for roughing and catching shall be $2.60 per turn each, of seven heats, and when eight heats are made the roughers and catchers shall each be paid $3 per turn. But the price for roughing and catching on small sheet mills shall be the regular $2.25 each per day of seven heats."

Other changes of minor importance were made.

The scales for tin and block plate mills, for rolling muck, bar, and finished iron, for sheet iron, for structural mills, continuous trains, wire rod mills, and for spike cutting, do not in the slightest deviate from the prices now paid. The Journeymen Roll Turners' scale, is an innovation. It is objected to by the manufacturers.

Nail Cutting Changes.

The greatest change in the new scale is that for nail cutting. When the card rate for nails is $2, the price for cutting 10d has been reduced from 16 cents to 14 cents, and 12½ per cent off instead of 10 per cent, when self-feeders are used. In the finishing list the reduction is even larger, being on ¾-inch from $4.17 to $2.58½. Three extras are also eliminated, and every effort made to assist the cut nail manufacturers in their fight against the encroachments of the wire nail.

Mr. W. L. Abbott, of Carnegie, Phipps & Co. on the 12th inst. wrote the President of the Workmen's Association a letter from which we make the following extract:

"1. The Homestead Steel Works cannot longer be operated successfully under a scale of wages established to apply to iron products, nor under conditions that have radically changed, and which did not contemplate the use of appliances and methods admitting of a largely-increased output without corresponding increase of labor. These improved facilities were acquired only through the outlay of large sums of money, on which capital we must have a reasonable return.

"2. To place ourselves upon an equality with our leading competitors an average reduction of wages of, approximately, 25 per cent is imperative.

"3. As a cure for the annual recurrence of wrangles and the dissatisfaction inevitably following the yearly agitation of the wage question, and in the Interest of our men quite as much as of ourselves, a sliding scale shall be established.

"4. The scale adopted shall be operative for not less than two and one-half years.

"This action is not taken in antagonism to organized labor, but it has been forced upon us by the unreasonable and shortsighted demands of that power which, like all power not carefully controlled, is apt to be used to destroy itself. We recognize the right of every man to get for his services the highest market price. Whether, as employers, we purchase such service from the individual or from an organization which controls him is immaterial to us."

PREPARATION AND PROPERTIES OF METALLIC MANGANESE.*

By Chas. Bullock.

The properties of manganese, like those of iron, appear to differ according to the method used in the reduction of the metal. When obtained from the oxide by heating with carbon, most authorities agree in the statement that the metal oxidizes so readily in the air that it can be preserved only under "rock oil," or in well sealed vessels. In water it is said to "oxidize rapidly, with evolution of hydrogen, and crumbles into a dark gray powder."

Cast manganese containing eight per cent. of iron is said to be unalterable in the air.

In the year 1869, some manganese prepared after the process of Brunner (the reduction of the chloride mixed with fluorspar, by means of sodium) was found to have as little tendency to oxidation as iron.

Repeating recently this process, pure chloride of manganese was fused in a clay crucible and poured on a stone slab, when cold it was pulverized and mixed with an equal weight of powdered fluorspar. This mixture, divided into portions of one ounce, was introduced into a French clay crucible, previously heated to redness. Eighty grains of sodium, cut into small pieces and freed from naptha, being added to each portion, the crucible was covered, and reaction allowed to take place before adding another charge. After six ounces of the mixture had been added, the contents of the crucible was covered with fused chloride of sodium in powder, the cover replaced and the heat carried to quiet fusion. After the flux became entirely fluid, the heat was continued for ten minutes. The crucible was then removed from the fire, and after cooling the metal was found as a button at the bottom.

Three crucibles, of the capacity of eight fluid ounces each were used at a time in a furnace without artificial blast. Care is necessary not to urge the heat too high, otherwise the crucibles will not resist the action of the fluorspar flux. The French clay crucibles (Beaufay) were used on account of their greater freedom from iron and silica; they also resist the flux better than the Hessian, black lead or iron crucibles.

The yield of manganese under favorable circumstances, was about 20 per cent of the chloride used.

Reduction was also tried by using fused chloride of sodium without fluorspar, the yield of metal was much less and differing in some of its properties from that obtained with the use of fluorspar. Manganate of soda was formed when sodium chloride alone was used as a flux.

Manganese thus obtained is very brittle, with a steel white fracture, so hard that a file will scarcely touch it, the edges of the fracture scratch, and almost cut, glass.

The metal retains the brightness of a fractured surface after prolonged exposure to the air, and appears not more disposed to oxidation than iron. It is entirely passive to magnetic attraction.

The specific gravity of the metal obtained when fluorspar was used was 7·072, when remelted under fused sodium chloride, the sp. gr. rose to 7·153.

The metal obtained without the use of fluorspar was less brittle, and had a different fracture; its sp. gr. was 7·231.

Authorities differ regarding the sp. gr. of manganese, ranging it from 6·85 to 8·013.

An examination of the metal obtained, using fluorspar as a flux, showed the absence of iron, and the presence of calcium, demonstrating the reduction of some of the latter metal from the spar. This may account in a measure for the sp. gr. on remelting under sodium chloride, as also the greater sp. gr. of the metal when the spar was not used. As calcium has the sp. gr. of 1·57, a small amount alloyed with the manganese would sensibly affect its gravity.†

The Nicaragua Canal Construction Company.—The annual meeting was held in Denver, Col., June 21st, and the following directors were chosen: A. C. Cheny, A. O. Cheny, Edward Holbrook, A. F. Hedges, R. A. Lancaster, W. L. Scott, H. C. Taylor, R. Sturgis, J. W. Miller, A. M. Hoyt, J. E. O'Shaugnessy and Daniel G. Jeffers.

Gathering Sulphur from Volcano Pits.—The bark "Belle of Oregon" landed at Philadelphia a few days ago 300 tons of sulphur gathered from the extinct volcanos in Japan. It is reported that the Japanese have recently found that the craters of some of the extinct volcanos with which their islands abound are rich in sulphur. The ship "Cheesbrough" has been chartered to load a similar cargo at Hakodadi, Japan, for Sandy Hook, at $7 per ton.

New York and Chicago Fire Statistics.—New York's fire department cost to maintain last year $1,962,346. There were 3,217 fires and the losses were $5,485,922, an average of $1,705.29 for each fire. The expenses of the Chicago department were $949,050, and the losses by 1,871 fires were $1,363,427, an average of but $728.72 for each fire. Owing to the immense values collected under single roofs and otherwise closely massed in New York city, such an average as that of Chicago would, under existing conditions, be simply unattainable here.

The Ordnance and Fortification Board.—This board has been considering the various items of appropriation in the last Fortification act, which becomes available on July 1st. The Ordnance Bureau has submitted recommendations for the expenditure of the various sums therein provided for, and it is now the duty of the board to report their opinion thereon to the Secretary of War. The board is also preparing regulations for testing the 12-inch mortar, which was delivered at Sandy Hook some time ago by the South Boston Iron Works for test, in anticipation of a contract for 50 or 100 of the same character.—*Army and Navy Journal.*

Safe Transportation of Sulphuric Acid.—Herr Bickmann has patented in Germany a process for enabling sulphuric acid for manufacturing purposes to be safely transported. He takes advantage of a property of certain salts—of which alkaline sulphates are representatives—by which they give up their water of crystallization when heated, and take it up again when cool; and he does so by mixing the salts in an *anhydrous* condition with a calculated quantity of sulphuric acid. The whole mass becomes granular, or may be formed into cakes; and when heated the whole liquefies, and may be used as if it were sulphuric acid, for the presence of bisulphate of soda does no harm in many utilizations of the acid.

Production of Sulphur in Italy in 1888.—We are indebted to Mr. A. de Forester, Charge d'Affaires of Italy, in Washington, for the following information concerning the sulphur production of Italy in 1888. It was furnished to this Legation by the Royal Ministry of Agriculture, Industry and Commerce:

	Tons.	Lires.		
District of Bologna.....	19,254	1,554,825	=	$310,965
Sicily.....	322,042	21,512,405	=	4,302,481
Naples.....	35,252	1,945,784	=	389,156
Total.....	376,538	25,013,014	=	$5,002,602

Railroad Extension in Australia.—Mr. Violette, representing a syndicate of British capitalists, has submitted his proposals to the governments of Western Australia and South Australia for the construction of a railway from Roebuck Bay to Angle Pole, near the Peake station. The distance is estimated at 1000 miles. The line is to be constructed on a 5 feet three inch gauge, similar to that of the line between Adelaide and Melbourne, and it is to be completed within twelve years of the signing of the contract. Prior to building a permanent line the contractors will run a light line and telegraph the whole distance. All auriferous and other mineral land is to be reserved to the crown. Crown lessees on the syndicate's concessions would not be interfered with, but the syndicate would become the landlord. The syndicate asks for a land grant of 35,000 acres per mile, the land to be settled along the line, and the syndicate to own and work the line. Mr. Violette, who is a French engineer, states that the proposals have been submitted to the governments of both colonies.

BOOKS RECEIVED.

[In sending books for notice, will publishers, for their own sake and for that of book buyers, give the retail price? These notices do not supersede review in another page of the Journal.]

Resultate der Untersuchungen des in der Eifel vor Kommenden Vulkanischen Sandes in Bezug auf seine Verwendbarkeit zur Mörtelbereitung. By Dr. Böhme. Published by Julius Springer, Berlin. 1889. Pp. 26, with two plates.

Annual Statistical Report of the Secretary to the Members of the British Iron Trade Association on the Home and Foreign Iron and Steel Industries in 1888. By J. S. Jeans. Published by E. & F. N. Spon, London. 1889.

Bulletin of the Agricultural Experimental Station of Cornell University. VI. Published by the University. June, 1889. 8vo., 8 pp.

The Minerals of New South Wales, etc. By A. Liversidge, F. R. S. With map and illustrations. Published by Trübner & Co., London. 8vo., cloth 320 pp.

Resources of Wyoming. 1889. By the Secretary of the Territory. Cheyenne *Daily Sun* print. 8vo., paper, 77 pp.

Cercle Chromatique, a treatise on the complements and harmonies of color. By Charles Henry. Published by Charles Verdin, Paris. 12mo, paper, 168 pp.

Rapporteur Esthétique, a treatise on the study and rectification of forms. By Charles Henry. Published by Charles Verdin, Paris. 12mo, paper, 22 pp.

PATENTS GRANTED BY THE UNITED STATES PATENT-OFFICE.

The following is a list of the patents relating to mining, metallurgy, and kindred subjects, issued by the United States Patent-Office.

PATENTS GRANTED JUNE 25TH, 1889.

405,700. Dumping Car. Percival Everitt and William C. Page, New York, N. Y.
405,705. Air Brake. Frederick A. Holleman, Oisterwyck, Netherlands.
405,716. Method of Cleaning Metal Castings. Joseph H. Potts, Philadelphia, Pa.
405,744. Machine for Making Wire Rope. Henry Root, San Francisco, Cal.
405,745. Pipe Coupling. Henry S. Ross, New York, N. Y.
405,747. Apparatus for Carburetting Air or Gas. Daniel J. Snyder and James Stephenson, Scio, Ohio.
405,754. Recovering Soda. Sabatian Wolf, Stahlhammer, Upper Silesia, Germany.
405,759. Gearing. Arza M. Benson, Cleveland, Ohio.
405,760. Centrifugal Governor. Henry L. Berger, Vermillion Parish, and Eduard Noel, Abbeville, La.
405,766. Apparatus for Converting Crude Metal into Malleable Iron or Steel. John W. Bookwalter, Springfield, Ohio.
405,767. Conduit for Cable or Electric Railways. William J. Brewer, New York, N. Y., Assignor of three-fifths to Thomas W. Rae, Frederick H. Reed, Walter Thompson and George N. McGibbin, all of same place.
405,795. Gas or Hydro-carbon Vapor Engine. Lewis C. Parker and Beaumont Parker, Kansas City, Mo.
405,812. Compound Engine. George Westinghouse, Jr., and Francis M. Rites' Pittsburgh, Pa.
405,817. Promoting Combustion in Furnaces. William P. White, Manchester, and Rovert Wallbank, Bolton-le-Moors, County of Lancaster, Assignors to James Henry Heap, Accrington, England.
405,824. Process of Chloridizing Gold Ores. Turner D. Bottome, Hoosick, N. Y., Assignor to John B. Tibbits, same place.
405,835. Lubricator for cylinders. James G. Gracey, St. Louis, Mo.
405,837. Steam Generator. Alfred Hasbrouck, Ithaca, N. Y.
405,845. Automatic Safety Clutch. George Le Clair, Oswego, N. Y., Assignor to the Le Clair Manufacturing Company, same place.
405,849. Condenser for Exhaust Steam. Bentley J. Rinehart, Camden, N. J.
405,858. Electro-Magnetic Motor. Nikola Tesla, New York, N. Y., Assignor to th Tesla Electric Company, same place.
405,866. Flux Carrier. James C. Bayles, East Orange, N. J.
405,882. Chill. William Fawcett, Rochester, N. Y.
405,884. Hydro-Carbon Burner. Thomas E. Hall, Kansas City, Mo.
405,914. Wire Solder Machine. Frederick W. Schultz, Baltimore, Md.
405,929. Riveting Machine. Jacob J. Unbehend, Syracuse, N. Y., Assignor to Judson L. Thomson & Co., same place.
405,936. Regenerative Furnace. Walter B. Wright, Chicago, Ill., Assignor to the International Gas and Fuel Company, same place.
405,956. Jet Attachment for Furnaces. Michael Foster, St. Louis, Mo.
405,965. Automatic Railroad Frog. Michael Leary, Utica, N. Y., Assignor of one half to James F. Mann, same place.
405,966. Process of Burning Culm or Pulverized Coal. Allan Mason, Brooklyn, Assignor to Herbert H. Sanderson, trustee, New York, N. Y.
405,971. Means or Apparatus for the Production and Distribution of Compressed Air. Victor Popp, Paris, France, Assignor to the Popp Compressed Air and Electric Power Company, Limited.
405,974. Dumping Wagon. George Worthington, Pittsfield, Ill.
406,006. Automatic Air Brake. Renaldo Solano, Brooklyn, N. Y., Assignor of two-thirds to John W. Howard and David R. Morse, same place.
406,011. Compound Locomotive Engine. Samuel M. Vauclain, Philadelphia, Pa.

* Read at the meeting of the Chemical Section of the Franklin Institute, May 21st, 1889.

† Sp. gr. of gray iron, 7·1; sp. gr. of white iron, 7·5; sp. gr. of pure iron, 7·84.

PERSONALS.

Mr. John F. Blandy, Mining Engineer, of Prescott, Arizona, has been appointed Territorial Geologist.

Mr. Hennen Jennings has resigned his position as Superintendent of the El Callao Mining Company, of Venezuela.

The Master Car Builders' Association of the United States met at Saratoga, N. Y., on the 25th inst., about 350 strong.

Mr. E. T. Turner, C. E., has been appointed director of the New York State Meteorological Bureau and Weather Station.

Mr. Tyng has been appointed Superintendent of the New York & Honduras-Rosario Mining Company, at Juancito, Honduras.

Mr. John D. Wing, senior member of the firm of Messrs. Wing & Evans, of New York, sailed for Liverpool on Wednesday last.

Mr. Louis Janin, Jr., the late assistant superintendent of the Santiago Gold Mining Company of the Republic of Columbia, is now in Mexico.

Mr. Platt K. Dickinson, well known in financial and mining circles in New York, is engaged in extensive land speculations near Bar Harbor, Me.

Mr. E. N. Riotte, manager of the New York Metallurgical Works, of New York, has gone to Montana on professional business. He will be absent about three weeks.

Mr. William Henry Woods, the President of the Alabama Mining Company, dropped dead in his office in New York, shortly after noon on the 26th inst. Mr. Woods was forty-nine years old, and had for some years been President and Manager of the Alabama Mining Land Company.

Dr. Persifor Frazer, of Philadelphia, was recently in the City of Mexico, having returned from a twenty days' visit to the Pachuca district, where he located an adit for the drainage and working of the mines of Pachuca, Real del Monte, Santa Rosa and others, in connection with Mr. Murdock, the promoter of the enterprise.

Mr. R. C. Ballard Thurston, Trustee of the Big Stone Gap Improvement Company of Big Stone Gap, Va., has been appointed Superintendent of the Kentucky Union Land Company, and after July 1st his headquarters will be Louisville, Ky. Mr. Thurston has retained his position with the Big Stone Gap Improvement Company.

Chief Engineer William H. Hunt, of the navy (retired), died in Washington on the 26th inst. at the age of fifty-seven. He entered the navy in 1853 as Third Assistant Engineer, and was promoted through the various grades to the rank of Chief Engineer, which last promotion he received in 1863. He was placed on the retired list in 1871 on account of disability.

The United States Geological Survey has commenced active operations in Idaho, making the examinations or preliminary surveys for an irrigating ditch to bring the waters of the Snake River to the plain between the Snake and Boise rivers west of the lava beds. We greatly regret to hear that the able chief of the parties having this work in charge has given some occasion to those who wish to discredit the survey.

Students from the School of Mines at Columbia College, New York, to the number of sixty, will again this year constitute a summer school on the shores of Bantam Lake, in Litchfield. The men will be succeeded by sixty others later in the season. They come from the advanced classes in the Scientific Department of Columbia, and go to Litchfield for the double purpose of enjoying the salubrious air and engaging in field work. Professor Monroe will have charge of the party. The students are expected to attend a lecture each morning at 8 o'clock, and afterward the time until dinner, at one, is to be devoted to field work, surveying and triangulation.

A special conference of delegates of the Brotherhood of Locomotive Engineers is to be held in New York within a short time. This powerful national organization has been in existence for twenty-six years, and has nearly 400 divisions, with 27,000 members. There is a scheme for the federation of this Brotherhood with all the other branches of the railroad service, including the Order of Conductors, the Switchmen's Association, the Brotherhood of Brakemen, and the Brotherhood of Locomotive Firemen. If this scheme should be carried out, the federation would be able to display a roll of nearly 100,000 members. The coming conference of the locomotive engineers will be secret.

The Columbia College, New York, has have established a new course in the School of Mines—that of electrical engineering, as already mentioned in a recent issue. The course will be under the direction of Prof. Francis B. Crocker, E. M., instructor in electrical engineering. The course will include lectures, the study of text books and practical instruction in electricity and electrical apparatus. The course will occupy two years. Graduates of the School of Mines, and of other institutions of like grade and standing, will be admitted to the course without examination. But in cases where there may be any doubt of the proficiency of such graduates they may be required to pass such examinations as shall be prescribed by the faculty

INDUSTRIAL NOTES.

The Belfast Mill, in Ironton, O., is running with the heating furnaces on double turn.

The Atlanta (Ga.) Machine Works, which have been standing idle for several months, have started up. Extensive repairs have been made.

The charcoal furnace at Attalla, Ala., which was erected by Chattanooga capital, has gone into blast. The furnace has a capacity of 50 tons daily.

The American Well Works Aurora, Ill., have added to their already large plant a new brass foundry, and have increased the capacity of their iron foundry. A new compound engine of their own make has been put in to supply the power for their factory.

The Ball Engine Company, of Erie, Pa., in addition to its large trade in furnishing electric light engines, is having quite a demand for engines for operating electric street railroads, and has furnished roads with engines in various parts of the United States, Canada, and Australia.

A number of furnaces of the Schuylkill and Lehigh Valleys, Pa., are about to start up again. The Topton furnace, which was blown out some time ago, with the prospect of remaining idle indefinitely, is being repaired by a large force of hands, and will be put in blast in a few weeks.

Victoria Furnace, situated in Rockbridge County, Va., will blow in about July 10th. Our correspondent writes us that Mr. Ed. Orton will be chemist and foundryman and Mr. A. Magoon, superintendent. Both of these gentlemen came from Ohio, where they have attained for their "Pencost" iron a wide spread reputation as a high silicon iron.

The Secretary of War has approved the recommendation of the Board of Ordnance and Fortifications, that a disappearing gun-carriage, built under the plans and specifications of the Pneumatic Gun-Carriage and Power Company, of Washington, D. C., be purchased from said company for $48,000. The carriage is to be tested as a type for the coast defences.

The Gallia Furnace, Ironton, O., built in 1846 by John Campbell and his associates, has been out of blast for ten years, but the company operate the ore mines and ship the ore to Welleston. They are also shipping charcoal to Madison furnace. Our correspondent writes us that the tract of land owned by this company is being gradually changed into a stock farm of large proportions.

The Ellis & Lessig Steel and Iron Company, of Pottstown, Pa., have announced a reduction in wages on the 1st of July. The men in the nail mill will be reduced 15 per cent, and in the nail plate mill, coopershop, machine and blacksmith shops 10 per cent. In the puddling mill of the company, where the hands are working under a sliding scale of wages governed by the price of iron, there will be an increase of 50 cents a ton for puddling.

Circulars are issued to the stockholders of the Thomson Electric Welding Company, giving right to subscribe to the stock of the International Electric Welding Company, share for share. The capital of the new company is $1,500,000, par $100. Rights are to stock of date June 21st and expire June 26th. The Thomson-Houston Electric Company's officials say there is no present intention of issuing another series of trust certificates.

The Eureka Improvement Company of St. Paul, Minn., made an assignment on the 26th inst. The amount involved is $700,000, considerable of which is held by Eastern parties. The Eureka Company was organized to deal in lands and electric motor enterprises in St. Paul. The assignment was made on an attachment; it was brought by Fowble & Fitz, surveyors. The crisis was expected.

The Maxim automatic guns, invented by Hiram Maxim, were tested at the naval proving ground at Annapolis, Md., on the 21st inst., before a board of officers. The test was preliminary to later trials, which will be necessary before the final report of the board is announced. One of the guns fired 750 shots in a minute, and the other 350. The guns worked satisfactorily. The Maxim gun is used in Germany, Russia and France, and is claimed to be superior to the Gatling gun in rapid firing.

The stockholders of the Ashland Fire Brick Company at its last meeting elected the following officers: W. C. Ireland, President; Harold Means, Vice-President; John Russell, Jr., Secretary and Treasurer; S. S. Savage, Superintendent. The sales of No. 1 brick from Olive Hill, Kentucky, clay have increased to a large extent throughout the South by having the advantage of cheap fuel and low rates over the fire-brick manufacturers on the Ohio side of the Ohio River. The company's property is situated in Boyd County, Kentucky.

Messrs. S. Robbins & Son, iron and steel bar manufacturers at Philadelphia, Pa., failed on the 26th inst. The liabilities of the firm are estimated at $120,000, and the assets at $70,000. The business was established in 1857 by Stephen Robbins. In 1874 Mr. Robbins put in a blast-furnace at an expense of $280,000. It proved to be unprofitable, and when Mr. Robbins died, in 1887, he was heavily in debt. The heaviest creditor of the firm is the Kensington National Bank. The bank obtained a judgment yesterday upon which execution was issued. The counsel for the firm says that the business may be continued.

CONTRACTING NOTES.

Our list of machinery and supplies wanted will be found on page xii. Manufacturers of machinery, engineers and contractors should also consult our directory of "Contracts Open" on the same page. This week, proposals are invited for the following new contracts: No. 1,455, Construction of Two Steel Cruisers for United States Navy; No. 1,456, Rebuilding Iron Bridge; No. 1,457, Building Iron Bridge; No. 1,458, Erecting Stand Pipe, Water Tower, etc.; No. 1,459, Building Protection Wall; No. 1,460, Street Lighting; No. 1,461, Electric Lighting.

GENERAL MINING NEWS.

Shipments of iron ore from the mines of the districts mentioned below for the season up to and including June 19th, as reported by the Marquette *Mining Journal*, were as follows:

	Tons. 1889.	Tons. 1888.
Marquette, Marquette District....	397,291	89,161
St. Ignace, " " ..	13,144	35,403
Escanaba, "	280,521	186,281
" Menominee District....	482,848	243,624
" Gogebic District.....	72,861	61,140
Ashland, "	380,086	161,385
Two Harbors, Vermillion District.	211,018	52,354
Total, tons.....	1,838,769	835,348

A new oil company, with large capital, is being organized in Cincinnati, and is practically a consolidation of the Kentucky Oil and Gas Company, of Louisville, Ky., and the Southern Oil and Pipe Line Company, of Cincinnati. Both companies have been quietly at work for a long time securing leases, and it is announced that they have secured leases on over 150,000 acres in one tract extending through Sumner County, Tenn., and Allen, Barren and Warren Counties, Ky. A pipe line to convey natural gas into Bowling Green is now being built. The land is bounded by two competitive water-ways and the railroads, by which Nashville, St. Louis, Cincinnati, Louisville and the Southern points may be reached. The oil is near the surface, and the field is 500 miles nearer the great southern and western market than any other known field. The company will construct railroads on its lands, and at once arrange to pipe oil to Louisville or St. Louis.

ARIZONA.

PIMA COUNTY.

The mining town of Quijotoa was destroyed by fire last week. The loss is said to be $60,000. W. S. Lyle, President of the Peer, Peerless, Crocker and Weldon mines, states that the fire did not do the least damage to the works at the mines or the mill. The mines and their works and the Peerless mill are fully half a mile from the locality of the fire.

Reports from local papers about the Quijotoa district state that the mines are looking well and a large amount of ore is now in sight. The mill is still running, though the force has been reduced to thirty men, and it is reported that the mill will be shut down temporarily on the 15th inst. There are a good many men at work in the vicinity of Covered Wells, and they are all doing well. The ore is shipped to Tucson. It is rumored that the Locomotive Mining Company will commence work on the Locomotive and Casa Grande mines in a short time, and this will be a benefit to the camp. Prospecting is going on all the time, though no important strikes have been made since the discovery in the Bullion mine. The mine is now idle and an effort is being made to sell it. The Papagos and Mexicans are continually working the placer diggings in the vicinity and bring in considerable golddust, which they dispose to the Quijotoa merchants.

PEERLESS MINING COMPANY.—Owing, as stated in our issue of the 8th inst., to the grade lowering in some of the stopes, and others that need further work to get in shape for breaking before a sufficient supply of milling ore can be had to run steadily, the mill was temporarily closed down on the 16th inst. Prospecting will commence shortly on ore which shows strength on the 200, 300 and 450 levels.

PINAL COUNTY.

[From our Special Correspondent.]

DE NOON, June 16.

There is nothing new in our county at present. All work is simply development. The three outfits below Casca Grande, viz., the Central Silver Company, owning the Silver Reef properties, the Golden West, owning the Golden West mine (this is Wernse's company), and the Lela Mining Company, owning the Monarch mine, the first two of St. Louis, the latter, of Kansas City, are erecting their mills, smelters, etc. They will all be fizzles and will be subject matter hereafter when the fizzle comes.

At the J. D. Reymert Mining Company's mines only development work is at present being prosecuted. The lack of water has caused the mill temporarily to close down. At the same time the company is boring a well from which it is hoped sufficient water will be obtained to run the 20 stamps of the mill. This kind of well, similar to those drilled in the oil fields of Pennsylvania, where the pump is placed at bottom of well and the oil raised by walking beam, etc., style of pump, is becoming quite popular in the dry regions of Arizona. One of the most successful is at the Vekal mine, where the water is lifted about 400 feet. Tests made showed the well capable of furnishing 50,000 gallons daily. Its actual capacity was never determined, as the amount stated was more than required. Some eight or ten have been sunk in Southern Arizona for cattle ranches, etc., and nearly all suc-

cessful. A well of this class with full outfit costs from $3,500 to $5,000, while the cost of raising 20,000 to 50,000 gallons would depend on the cost of cord wood at the locality, one or two cords a day sufficing for above amount of water.

YAVAPAI COUNTY.

ST. LOUIS YAVAPAI MINING COMPANY.—The entire property belonging to this company, which has been advertised for sale, was sold on the 19th inst. by Messrs. H. H. Wernse and John W. Cover, agents for Trustee Charles S. Taussig, to Messrs. W. C. Schultz and Albert Arnstein, who are the trustees for the bondholders, for the sum of $50,000. This sale was made as a mere matter of form and for the purpose of perfecting the title of the bondholders, who, it is said, will resume operations early next fall.

CALIFORNIA.

AMADOR COUNTY.

AMADOR GOLD MINE, LIMITED.—Reports dated the 6th inst. state that, as the hoisting works are nearly completed, some of the men on that job have been discharged. There are now about 70 on pay roll, and the force will not be reduced below 60. Of the £5,000 received, $22 000 were paid out on the 1st. There are some bills to pay yet. In our issue of the 1st inst. we referred to the organization of this company.

COLORADO.

The Colorado Mining Stock Exchange, at Denver, to which we referred in our issue of the 8th inst., will be open for business about the 5th of July.

DOLORES COUNTY.

The Adams concentrating mill at Rico, is now running on the waste rock obtained from the sulphide mines of Newman Hill, which runs from 30 to 80 ounces silver per ton. It is readily concentrated into a high-grade product. The Pelton wheel, placed in position a short time ago to supply power for the mill, is proving a success.

GARFIELD COUNTY.

Mr. E R. Holden is reported to have purchased the Bailor Ranch, commencing at about one mile from the city limits of Glenwood Springs. He will erect a large smelting plant on the ground.

LAKE COUNTY.

LEADVILLE CONSOLIDATED MINING COMPANY.—Secretary Charles A. Cameron informs the ENGINEERING AND MINING JOURNAL that the financial condition of the company on June 1st was as follows: Cash on hand, $3,800: debts, $4,000.

PRESIDENT QUINTETTE MINING COMPANY. — The property of this company has come under the hammer, and has passed into the possession of Mr. Amos Henderson, of Leadville, for $6,000. The property included the dressing works in Tennessee Park, and the mines and machinery in Temple Gulch, St. Kevin District, and the sale was made by virtue of a certain deed of trust given by the former owners, among whom were a number of St. Louis people, to secure debts of the company. It is said that the property will be consolidated with the Reed and National mines, which are located upon the extension of the President vein. Commenting upon this sale the Leadville *Herald-Democrat* says: "The President has been a very good mine, and probably is now, also. Its failure has been due to bad management and the burden of debt which has accumulated therefrom. The success of the enterprise depended upon the success in dressing the low-grade ore which had been opened in a large body in the mine. The ore was of extremely low-grade, but it was of such a character that it could be easily dressed, and profitably, if the operation of mining and dressing were economically conducted. The mill, however, was poorly designed, and instead of being located close to the mine, where there was plenty of water and a good site, was built in Tennessee Park, three miles away, which arrangement was not favorable to economy."

SMALL HOPES CONSOLIDATED MINING COMPANY.—The annual meeting of the stockholders was held in New York City on Tuesday, the 24th inst. Over 200,000 shares were represented. The following trustees were elected: R. C. Kerens, Eugene Cary, R. C. McCormick, F. Blankenhorn, Thomas Moore, Jr., C. A. Cameron, Calvin Hood, Peter A. Hegeman, Logan H. Roots. At a subsequent meeting of the board of trustees, R. C. McCormick was elected President; R. C. Kerens, Vice-President, and C. A. Cameron, Treasurer and Secretary. The usual annual reports were read. Secretary Cameron informs the JOURNAL that the cash balance in Leadville, June 1st, was $1,498.69, and in New York, $3,404.30, in addition to the reserve fund of $55,655 35, making the total cash surplus on the 1st inst., $60,648.34. A dividend of $25 000 was declared in May, which accounts for the depletion of the dividend fund. The reserve fund, of course, remains intact.

LAS ANIMAS COUNTY.

Dr. H. B. Hayden of Raton, is at present in Trinidad with a view of locating there an extensive lapidary for the cutting and polishing of slabs of agate and topaz. He asks for a small piece of land rather centrally located. The works will manufacture fancy and expensive ornaments. The plant for this work will, while small, be expensive, as saws, etc., for cutting and polishing the stones, will be of diamond points and the labor employed will be very high priced.

PITKIN COUNTY.

[From our Special Correspondent.]

It is reported that Mr. E. R. Holden has purchased the Rust Sampling Works at Aspen.

Mr. Franklin Ballou, of Leadville, it is reported, has opened up a pay mine on what is known as West Aspen Mountain. The ore is said to be absolutely free from refractory elements, and carries a large percentage of lead.

ASPEN REDUCTION AND REFINING COMPANY.—This company was recently organized in St. Louis with a capital stock of 1250 shares of a par value of $100 each. The stock in the organization was all taken by L. M. Rumsey, Moses Rumsey, Paul E. Fusz, A. B. Ewing, C. D. McLure and Louis Denstrom, of St. Louis, and Charles H. Lawrence and E. A. Clark, of Chicago. W. Thomas Hart, of Aspen, Colo., is the promoter of the company and retains 250 shares. The St. Louis gentlemen named above are all heavily interested in the Granite Mountain Mining Company, of Montana, owning between them 180,000 shares. It is the object of the new organization to erect a large plant having a capacity of 100 tons daily at Aspen for the reduction of the dry ores of that district by the Russell process. A committee consisting of Messrs. Clark, McLure and Fusz have just returned from Aspen and express themselves favorably as to the outlook for success in the enterprise. They are now arranging with the railroad companies for satisfactory rates on their materials, salt and chemicals and bullion. The company propose erecting the works at once under the direction and superintendency of Mr. Hart who has had an extended experience in the wet treatment of ores. The public will be interested in the outcome of the enterprise, as it will be the largest plant yet erected to operate the Russell process.

MIDLAND CONSOLIDATED MINING COMPANY.—About two hundred tons of lime rock is shipped to the smelters of the State daily from the quarries of this company in Frying Pan.

SILVER BELL —Mr. H. F. Selleck, of Denver, who is largely interested in the lease on the north end of the Silver Bell mine, has just purchased a 20 horse-power double engine and 25 horse-power boiler, all new, to put on the lease. The work is progressing rapidly. The shaft is now 70 feet deep.

SAN JUAN COUNTY.

NORTH STAR MINING COMPANY.—This company, on King Solomon, is putting up a 50-ton concentration plant. The plant will cost $40,000 or $50,000.

SUNNYSIDE EXTENSION.—A 20-stamp mill is being put up on this mine, at the head of Mastondon Gulch, about 12 or 15 miles from Silverton. Its capacity will be 50 tons in 24 hours. Six bumping concentrators are to be put in. The Sunnyside Extension is a rich gold mine. The mill is to be driven by electricity. A tramway 2,500 feet in length is to be constructed.

DAKOTA.

LAWRENCE COUNTY.

It is reported that a large company is being organized to take hold of a group of tin mines in the southern hills. The preliminaries are in charge of Messrs. A. H. Harris, of St. Louis, and Robert Florman, of Rapid City.

BIG MISSOURI.—According to the Deadwood *Times*, an important strike is reported in this mine, lying west of the Homestake. Discovery occurred in the open cut, and already shows a twenty-foot face. The handsomest specimens ever produced by the belt are displayed. The ore yields, pan test, from $30 to $150 per ton.

BUXTON MINING COMPANY.—This company, which has its headquarters in Clinton and owning mining claims in the Black Hills, has been reorganized in consequence of the sale of a part of the stock owned by the Ankeny estate. The sale was for cash and $36 000 worth of stock changed hands. The Ankeny estate retains a large interest in the new company, and the new stockholders and those who have added to their previous investments in the Buxton Company are among the most prominent business men and capitalists in Clinton. The reorganized board of directors is as follows: Philo E. Hall, Horace Williams, P. S. Towle, Artemus Lamb, O. P. Ankeny, B. F. Ankeny and Welker Given. The officers elected at the meeting yesterday are: President, P. E Hall; vice-president and treasurer, P. S. Towle; secretary, H. W. Seaman.

DEADWOOD-TERRA MINING COMPANY.—The improvements contemplated by the company show that the Terra mill will be taken down and stamps added to the Deadwood, together with 40 new stamps, making the capacity of the works 200 stamps, Graders are at work, and the new mill will be pushed to early completion. Messrs. Lounsbery & Co. inform us that the bullion product for May was $55,109.39.

HOMESTAKE MINING COMPANY.—Messrs. Lounsbery & Co. inform us that the bullion product for May was $81,096.08.

ST. LOUIS MINING COMPANY.—This company, in which St. Louis parties are interested, is at present making arrangements to develop its property, and the contract has been let to sink a 100-foot shaft. The claim adjoins the Uncle Sam and is said to be an extension of that vein.

YANKTON COUNTY.

The proposition of Yankton has been accepted by Milwaukee capitalists for the erection of a cement works, and work will be commenced shortly. The company, it is stated, will put in a $100,000 plant and work 100 men.

GEORGIA.

WHITFIELD COUNTY.

CHATTANOOGA MINING AND MANUFACTURING COMPANY.—This company, composed of Chattanooga, Boston and Lynn, Massachusetts, capitalists, has purchased 2,000 acres of manganese and brown hematite ore land adjacent to Tunell Hill, Ga., and 26 miles from Chattanooga, and have commenced mining the manganese. The company will build a railroad to the mines, and a blast furnace for making spiegeleisen at Chattanooga.

IDAHO.

LEMHI COUNTY.

VIOLA MINING COMPANY, LIMITED.—It is reported that a portion of the hoisting works of the Viola mine at Nicholia was recently destroyed by fire, together with the timbering of one of the shafts for 200 feet in depth. It is stated that this will entail a loss of $1,200 to $1,500, besides stopping work in this portion of the mine for some time.

INDIANA.

The attempt of the State Board of Charities to settle the coal miners' strike at Brazil failed on the 26th inst. The operators and miners refuse to yield their positions. Further negotiations will be continued by committees. The semi-weekly relief fund on the 26th inst. amounted to $334, which was equally divided among 5,478 dependents. The fund was 100 per cent less than on Friday last.

MICHIGAN.

COPPER MINES.

CALUMET & HECLA MINING COMPANY.—The new stamp heads of the Calumet mill are ready to begin operations. Five heads will be constantly employed in the Hecla mill, while any variation which may take place will be in the Calumet division, where from five to seven heads will be worked alternately with the remaining four to six heads. With this work it is calculated to keep up the output at 2,500 to 2,800 tons per month. As has been previously announced, all contemplated improvements have been postponed for the present. This includes the contemplated new wheel house and the new water-works and engine building for the engine "Michigan," which is now on the ground. The work on the new coal dock, which was commenced this season, will be completed before fall; an addition 130 feet long is being added. Mr. Henry Coke, the new assistant superintendent, is placed under Superintendent F. G. Coggin, as assistant. Mr. Fisher, who temporarily held this position, has been given charge of the Calumet mill.

PENINSULA MINING COMPANY.—The other Ball head of stamps, which is located in the mill, is being overhauled, and will be put in commission. Two canvas washers are being connected with the three Evans slime tables, and will be used hereafter in connection therewith. The operations of opening up and exploring the mine are still progressing, while enough stoping is being done to keep the one head running.

MONTANA.

DEER LODGE COUNTY.

ANACONDA COMPANY.—The company is at present at a depth of 1,000 feet, and stoping continues throughout the whole mine. From the Butte *Inter-Mountain* we learn that on the 1,000-foot level everything looks as well as in any other part, though to take the whole ore-body it is not as rich in copper as in the upper workings, the ore carrying a higher percentage of iron. There is daily hoisted at the Anaconda mine between 500 and 600 cars per shift, averaging 1,800 pounds per car. Two pumps are used in keeping the mine free of water. One is stationed at the 400 and the large one at the 1,000-foot level, keeping the mine entirely free of water. The St. Lawrence, on the east is at present a depth of 800, as it is called, though the actual depth of the mine is 872 feet, and at present the management is drifting to connect with the 1,000-foot of the Anaconda. Every level in this mine is connected with the Anaconda with the exception of the 700 and 800-foot levels. All the levels in this mine are actively engaged in producing its regular quantity of ore, with the exception of the 100-foot level, where at present they are actively engaged in catching up the old cave that occurred some time ago. The average hoisting of the larger engine at this mine is between 600 and 700 cars per shift. The Mountain Consolidated, situated on the west of the Anaconda, and part and parcel of the Chambers' syndicate of mines, is virtually one of the Anaconda's producers. The present depth of the shaft is 550 feet and levels are run at every 100 feet. The drift to connect with the Buffalo has been completed, but a raise has to be finished at least 75 feet before a connection can be made. The singular fact remains that in the Buffalo the water in the shaft has not decreased, though the drift in question is directly under the shaft. Between 400 and 500 cars of 1,800 pounds each are daily hoisted from the mine. The Green Mountain, Wake-up, Jim-High, Ore-Modoc and Mabel, all belonging to the Chamber syndicate, are at present in a state of idleness with but few men working, other than those who are doing the necessary dead work, pending the completion of the smelter in course of construction at Anaconda.

SILVER CHEST MINING COMPANY.—This property, which is located in close proximity to Philipsburg, and although its development was not commenced until last fall, already offers most favorable indications; machinery for extensive development of the property is now being purchased, including an air pump, hoist, drills, boiler, engine, etc. The boiler has arrived and is in position. The tunnel on the Bluebird, which is one of the principal claims in the group, is already in over four hundred feet. This will be continued some 2,000 feet further, and the sinking of a shaft several hundred feet will also be begun at once, and other developments of less importance will follow. Messrs. Tibbetts, McWilliams & Co. obtained a bond from Al. Hudlemeyer and others last fall on these properties, which embraces the Silver Chest, Combination, Trade Dollar, Retta, Bluebird, Viola and the Sunday claims. They are located south of the San Francisco. The vein was traced a distance of more than 5,000 feet, and in the tunnel on the Bluebird they have been on the ledge ever since the work was commenced. Some ore has been taken out,

but it has been low grade. We understand that the work now to be done is for thoroughly testing the property, and if it proves satisfactory to Mr. Clark and his friends, which in all probability it will, a transfer will follow.

SILVER BOW COUNTY.

ARGENTINE MINING COMPANY.—The company has purchased the following group of mines and mining claims: The Grand Republic, The Mastodon, The Argentine, The Mogul and the Contact. The Grand Republic has a shaft 4 by 6½ in the clear and 55 feet deep. An additional force of men will be put on immediately. The shaft will be sunk 100 feet before cross-cutting the lead. Some of the ore found in the croppings is very rich, consisting of brittle silver, ruby and black sulphurets. The mines are situated on the head of Telegraph Gulch, about four miles southwest from the Oro Fino District. The company has put on the market 20,000 shares of its treasury stock at 10 cents per share.

PARROTT COPPER COMPANY.—At the Parrott smelter some little difficulty has been experienced by the burning out of one of the large blast furnaces, and now the company is confined to the use of the two remaining. The *Inter-Mountain* says that the large one constructed last year became so expensive by the consumption of so much coke that work on it was entirely suspended, though with the two now in use about 300 tons per day of second-class ore is disposed of. A new matte furnace is at present under construction, but it will be some time before it will be completed.

NEVADA.

ESMERALDA COUNTY.

BIG INDIAN.—This mine, near Hawthorne, has recently been purchased by State Senators Forbes and E. D. Boyle, who will erect a stamp mill near the mine.

GARFIELD MINING COMPANY, LIMITED.—The production in May amounted to $6,400; the revenue expenses to $7,300; capital and development expenditure, $1,700; tons crushed, 260. Five stamps working 24 days.

MT. DIABLO MINING AND MILLING COMPANY.—It is reported that a 20-foot vein of good ore has been struck between the fifth and sixth levels of this mine. Cross-cuts are being run between the fourth and fifth levels to cut the ledge.

EUREKA COUNTY.

CORTEZ MINES, LIMITED.—The results for the month of May: Production, 40,600 ounces; expenses, $15,500.

HUMBOLDT COUNTY.

Deeds have been recorded from H. H. McColley, J. H. MacMillan, and N. Levy & Co., to L. P. Brenan, of Philadelphia, for the Golden Era mines, Nos. 1 and 2, and the Great West mines, in Rebel Creek District, and also the Silver Wave mill and water right, in the same district. A deed from H. H. McColley to L. P. Brenan for the Flat Creek mine was also recorded. The mines have been more or less developed, and the ore carries considerable gold as well as silver.

STOREY COUNTY—COMSTOCK LODE.

We condense the following from the Virginia City *Chronicle:*

A low stage of water in the Carson River during the ensuing four months of the current year will result in but a slight curtailment of the present bullion yield of the Comstock. The Savage & Crown Point will be the only mines affected, and the daily ore shipments from the lode will not be reduced more than 150 tons below the average if shipments from these two mines are entirely suspended. The California mill will take the place of the Eureka, and steam will be used as a motive power at the Brunswick when the water in the Carson River fails.

CONSOLIDATED CALIFORNIA & VIRGINIA MINING COMPANY.—Up to the 21st inst. $147,808.40 was shipped on June account.

OCCIDENTAL MINING COMPANY.—The new 20-stamp mill will be in full operation before July 15th.

SUTRO TUNNEL COMPANY.—Mr. Theodore Sutro informs the ENGINEERING AND MINING JOURNAL that the receipts for the three months ending June 1st amounted to $80,938.63. The total disbursements for that period were $22,713.06, leaving $58,225.57 as the net profit for the first quarter of the company's fiscal year. Inasmuch as several San Francisco journals have erroneously attributed to the ENGINEERING AND MINING JOURNAL an official statement that the westward extension of the Sutro tunnel will positively be commenced in August, it is proper for us to say on the authority of President Sutro that while he personally is heartily in favor of such a project, the company has not taken any official action on the matter, and in fact can not until the process of reorganization through which the company is now passing is completed. In the autumn, however, provided that the affairs of the company are then all adjusted, and if the company has on hand in cash a surplus over the amount necessary to pay the first coupon on the new bonds, Mr. Sutro will probably endeavor to obtain the consent of the stockholders to the further extension of the tunnel. In any event, according to Mr. Sutro, it will be October at least before work of this nature is commenced.

NEW MEXICO.

SANTA FE COUNTY.

LUCKEY.—This mine at San Pedro has recently become a large ore producer. The East Las Vegas *Optic* states that it was formerly worked by the Benton brothers and others, who took out large quantities of iron ore for fluxing purposes. The mine was not considered very valuable for any other purpose as a one-fifth interest in the property was offered last winter for $200. The owners of the property were then Col. R. W. Webb, Sam Baldwin, Dick Giblin, Kirk White and the Benton brothers. Early in 1889 Tom Wright, an experienced Colorado miner, took a lease on the mine and struck a rich blanket vein of the carbonate ore which has panned out successfully. A few weeks ago Giblin and the Benton brothers sold out to Judge H. L. Warren and Tom Wright. Over 100 teams are now engaged in hauling the ore to Cerrillos, twenty miles distant, and the daily ore output is about five cars, shipments being made to Socorro and Pueblo.

OHIO.

LAWRENCE COUNTY.

We are advised by our correspondent that Mr. Crichton will use a diamond drill on his lands in Texas Hollow in search of the Waterloo coal seams which are supposed to exist there.

PENNSYLVANIA.

Veins of both hematite and bog ore, which are rich in iron, have been found on land south of Lock Haven. Samples of the ore are now being analyzed, and the work of opening the veins will shortly commence. The intention of the capitalists who sent the expert to examine the land is to mine and ship the ore to other points, where it will be used to feed furnaces and rolling mills.

PHILADELPHIA & READING RAILROAD COMPANY.—The company furnishes the following statement of the operation of the railroad for May, 1889, as compared with the same month of 1888: Gross receipts, $1,617,673.29, a decrease of $128,967.39; gross expenses (excluding rent and interest), $957,752.62, an increase of $87,193.64; profit in operating, $659,940.67, a decrease of $216,161.03; profit from December 1st to date, $3,237,586.18, a decrease of $157,554.37, as compared with the corresponding period of the previous year.

OIL.

Exports of refined, crude, and naphtha from the following ports, from January 1st to June 22d:

	1889. Gals.	1888. Gals.
From Boston	2,251,517	1,474,772
Philadelphia	58,913,511	52,817,366
Baltimore	1,782,077	2,279,939
Perth Amboy	9,301,433	10,941,966
New York	187,360,851	161,664,885
Total exports	259,609,389	229,179,128

TENNESSEE.

CAMPBELL COUNTY.

A meeting of the operators of the Jellico coal mines was held at Louisville, Ky., recently for the purpose of discussing the advisability of putting mining machinery in the various mines, and it was decided to investigate the various mining machines now in use, and for that purpose take up surveys on the ground by visiting the different coal fields where the machines are in operation. Great stress was laid during the meeting upon the subject of electricity and its application to mining machinery, as well as the lighting of mines and for other purposes connected with mining.

UTAH.

SUMMIT COUNTY.

In the case of the Utah Mining and Manufacturing Company, of Cleveland, vs. Dickert & Meyers Sulphur Company, motion to modify and change the opinion of the court has been overruled by the Utah Supreme Court.

VISHNUE.—This group of mines has been bonded to McCornick & Co., of Salt Lake, who are agents for a syndicate of mining operators in France, for six months. Mr. Dan Fitzwater has been appointed superintendent of the works by the new management. Repairing tunnels, levels, shafts, etc., has already commenced, and as soon as such necessary dead work is completed a large force of men will be put at work running new tunnels and opening new stopes. The lower levels, now under water, will be pumped out.

SALT LAKE COUNTY.

FLAGSTAFF, LIMITED.—This company has been organized in London with a capital of £240,000 in £1 shares. The objects are: To acquire from the New Flagstaff Mining Company, Limited, and the liquidator thereof, the mines and mining property of that company situate in the county of Salt Lake City, and all the other property and assets of the company. There shall not be less than three nor more than seven directors. The first are J. C. Bolton, G. W. Bacon, G. Burnell, Dr. C. Dunhill, W. Ururck, and E. Zuccani. Qualification, 200 shares. Remuneration, £100 each.

APEX MINING COMPANY.—The company has made its initial shipment for the season last week. The leasers of the dump will also soon be shipping their product.

CRESCENT MINING COMPANY.—The company is working about sixty men and the shipments of first-class and concentrating ore are very heavy. Two six-inch air lines are being put in and as soon as the two big pumps are started up sinking in the big incline shaft will be resumed.

FOREIGN MINING NEWS.

CENTRAL AMERICA.

HONDURAS.

NEW YORK & HONDURAS ROSARIO MINING COMPANY.—Justice Andrews, in the Supreme Court Chambers, New York, on the 21st inst., granted a motion requiring Civil Engineer Augustin Baldwin to furnish a bill of particulars in a suit brought by him against this company, to recover $25,000 damages for loss of health, which, he says, resulted from the hardships he was compelled to undergo while in the company's service. He says that at San Juancito, Honduras, he was required to live in a hole in the mountain infested with vermin and covered only with a thatched roof. He was stricken down with the Chagres fever and was compelled to give up his situation.

SOUTH AMERICA.

REPUBLIC OF COLOMBIA.

SANTIAGO GOLD MINING COMPANY.—Since the death of the late manager of this company, Mr. D. C. Kline, work has been suspended at the mines. A former owner of the property and a stockholder in the present company, Col. Farrand, will hereafter personally superintend the mining operations. Col. Farrand left New York on the 20th inst., and will immediately proceed to the Santiago mine.

TOLIMA MINING COMPANY.—At the annual meeting of this company, held on the 18th inst. in New York, Messrs. William T. Black, John Cummins, Franklin H. Kalbfleisch, G. W. N. Yost and Henry Cummins were elected directors, and they organized by the election of Henry Cummins, President; Wm. T. Black, Vice-President; F. H. Kalbfleisch, Treasurer, and C. C. Alden, Secretary. The company owns the Bocorná hydraulic gravel mine, near Honda, State of Tolima. It commenced washing in February with a small amount of water, partly owing to the extreme drouth then prevailing in that country, washing only 10 days in that month and cleaned up $240; and a nine days' run in March they cleaned up $390, and 14 days' washing in April gave $420, while a 15 days' run in May produced $1,080, at a cost of less than $400 at the mine. This prospect work is said to have demonstrated the richness of the gravel of which the company has many hundreds of acres, varying in depth from 40 to 200 feet. An adjoining mine, the Orita, is at present producing, and has for a long time produced, from $6,000 to $10,000 per month, while the Malpaso, also near by, is producing from $15,000 to $25,000 per month, their product being in proportion to their supply of water.

DIVIDENDS.

The following dividends have been declared:

American Dredging Company, semi-annual dividend of 3 per cent. and an extra dividend of $3 per share, payable July 5th at 234 Walnut street, Philadelphia, Pa.

Dunkin Mining Company, of Colorado, dividend No 29, five cents per share, or $10,000, payable July 15th by Farmers' Loan and Trust Company, 33 William street, New York City.

Pulaski Iron Company, of Puluski City, Va., has just declared a dividend of 14 per cent for the fiscal year.

ASSESSMENTS.

COMPANY.	No.	When levied.	D'lnq't in office.	Day of Sale.	Amn't per share.
Andes, Nev.	35	June 12	July 18	Aug. 8	.25
Bellevue-Idaho, Id.	....	May 11	June 17	July 6	.10
Best & Belcher, Nev	43	June 6	July 11	Aug. 1	.25
Crocker, Ariz.	6	June 14	July 19	Aug. 13	.10
Equitable T., Utah	34	May 14	June 20	July 15	.05
Eureka Cons., Nev.	12	June 12	July 15	Aug. 7	.50
Golden Fleece, Cal.	14	May 21	July 20	Sept. 16	17.00
Gould & Curry, Nev	5	May 1	June 5	June 27	.30
Goodman, Nev.	6	June 15	July 20	Aug. 24	.05
Hartshorn, Dak.	3	Apr. 27	*May 25	*June 29	.00½
Nevada Queen, Nev	5	June 3	July 9	July 30	.50
North Rapidan, Nev.	9	May 1	June 10	July 10	.01
†Pinal Cons., Ariz.	52	May 15	June 21	July 12	.05½
Ophir, Nev.	4	May 11	June 13	July 2	.50
Original, Nev.	12	June 12	July 25	Aug. 14	.25
Seg. Belcher, Nev.	95	June 4	July 8	July 29	.25
Sierra Nevada, Nev.	38	June 7	July 11	July 31	.25
Union Cons., Nev.	13	May 13	June 19	July 10	.25
Weldon, Ariz.	...	May 13	June 18	July 9	.10

*Delinquent day and day of sale postponed to dates given above.

†Notice is given that assessment No. 8, of ten cents per share, levied April 13th, 1889, upon the capital stock of the Pinal Consolidated Mining Company was rescinded by the directors at a meeting held May 15th, 1889.

MINING STOCKS.

New York.

FRIDAY EVENING, June 28.

During the latter part of the week, to-day particularly, there has been more than the usual inquiry for mining shares, and in a number of instances values have perceptibly stiffened. There are few sellers of the stocks most in demand, however, and consequently the record of actual transactions has not been materially increased.

The Committee on Mining Securities has ordered that the shares of the ill-famed "Security," of Colorado, which so notoriously belied its name to investors, be striken from the list of the Exchange on September 1st. This allows the members the usual sixty days within which to close all outstanding contracts.

It is encouraging to note this first effort of the Exchange to disown some of the disreputable concerns that have been and still are a standing disgrace to it.

Something like a year ago the "Security" stock ceased to represent any property whatever, the mine having been sold out and passed into other hands. The stock should never have been listed, as we fully advised at the time, and keeping it on the exchange long after it ceased to represent anything, is only one illustration of the policy of the Exchange which has been so hurtful to legitimate mining interests, as we point out editorially on another page.

The Governing Committee of the Consolidated Ex-

change, on the recommendation of the Committee on Mining Securities have reduced the charge for listing stocks from $300 to $50.

San Sebastian is in demand, and the price has advanced from 7@27c. The impression prevails that there is a movement under way to create a boom in this stock, based, no doubt, upon the resumption of work at the mines of the company, as reported in an interview with Secretary Blauvelt, in our Mining News columns last week. The officers of the company, however, tell us that they do not in any way attempt to influence the Exchange quotations, and that they are not to be charged with any manipulation of the stock.

The Phœnix, of Arizona, shareholders will shortly be asked to attend a meeting, at which a plan of future operations will be presented. They will probably be asked to ratify a mortgage for $11,000, to be issued to the trustees, Messrs. Curtis, Hardy and Wallace, who have bought up all the outstanding claims against the company, as stated in this column last week. A thousand shares were sold during the week at prices ranging from 30@35c.

There is still some demand for Homestake. According to the figures given in our mining news, the bullion produced for May was about the same as usual. Owing to the circuitous and complicated manner in which the monthly financial statements of this company are prepared, the latest cash balance of the company obtainable from the New York agents is that for April 1st, three months ago. Inasmuch as so large an amount of Homestake stock is held in New York, it certainly seems as though more expeditious work might be expected and even demanded. No sales of the stock are reported, and Caledonia shows one sale at $3. Iron Hill declined from 54 to 40c. The other Black Hill stocks were neglected.

Kingston & Pembroke shows an advance from 75c. to $1.25.

There is little doing in United Copper, and the price continues to be steady at from $1.10 to $1.20.

There is little or nothing doing in the Colorado stocks. No sales were made in Aspen. Cashier shows one transaction at 4c. Lacrosse was active as usual, selling at 9c. and 10c. Monitor sold at 2c. and 3c. Plutus declined from 90c. to 85c. Little Chief sold at 30c. and 35c. Iron Silver at $1.90. Colorada Central, in which little or nothing is doing at the present time, shows transactions amounting to 800 shares at from $1.85 to $1.95. Catalpa advanced from 12½c. to 20c.

Seven cents is still being paid for Rappahannock.

Mutual continues to remain stationary at $1.45.

Considerable attention was directed to Ontario, and several sales were made at from $34.25 to $35.25. Horn Silver was also active, but showed a downward tendency, the price going from $1.10 to 95c.

The copper stocks again attracted some attention in this market. Atlantic shows a sale at $9.50. The business in Calumet & Hecla amounted to 15 shares; the price declined from $209.13 to $207.50. Tamarack was also lower, going from $104.13 to $103.13; Allouez ruled at 85c.

Boston & Montana shows only one transaction at $39.13. Montana was neglected at 40c.

Mining propositions are plentiful in New York nowadays. Offerings extending from Alaska gold mines to Nicaragua silver properties, and including claims in various stages of development in Colorado, California, Montana and New and Old Mexico, are among those that have been brought to our attention. London has lately evinced a more decided inclination toward American mines, and we understand that a number of properties will be taken there early in the autumn.

There was considerable business in Silver King, and since the Bonanza firm has now control of this property, no doubt efforts will be made to boom the stock. This week it was daily dealt in and advanced from 72c. to $1.05.

For the first time in several weeks sales were made in Sutro Tunnel stock, the price of which ruled at 7@8c. The trust certificates were not dealt in until to-day, when they sold at 60@70c.

In the Comstock shares there is nothing new to report. Consolidated California & Virginia was active, and advanced from $7.25 to $7.75. Crown Point ruled at $2.50. Ophir at $4. Gould & Curry at from $2.15 to $2.20.

Hale & Norcross declined from $3.50 to $3 25, Savage at from $2 to $2.10, Yellow Jacket at $3. Alta advanced from $1.30 to $1.70, but later declined to $1.25. Best & Belcher went from $2.90 to $3.25.

Bullion sold at 85c. Exchequer at 90c. Mexican at $3.30. Occidental declined from $1.50 to $1.40. Potosi was firm at from $1.75 to $1.80. Union Consolidated sold at $3.35, and Utah went from 95c. to $1.05.

Eureka Consolidated shows a few transactions at $1.90.

Commonwealth declined from $4.45@$4.15. Belle Isle shows a few sales at 20@25c., and North Belle Isle one at 95c.

There was again a downward movement in Plymouth Consolidated, which declined from $9.50 to $9.

Brunswick shows a transacting at 5@6c.

Dullness continues to be the feature in Bodie stocks. Bodie Consolidated sold at from $1.30 to $1.35, and Bulwer at 35c.

In the Amadors, Astoria continued to sell at 20c., and Middle Bar at 23@24c.

Boston. June 27.

[From Our Special Correspondent.]

There is very little doing in copper stocks, the attention of speculators being absorbed in the various trust companies now in the market, which offer inducements for large profits or losses, and for the time being everything else is neglected. Calumet & Hecla and Boston Montana Copper have been more or less traded in for investment purposes, the former being quite strong at $207@$209, and the latter firm, at $38¼@$39¼, with the latest sale at $38⅛.

Very little doing in Tamarack, which is, however, firm, at $103½@$104.

Butte & Boston is in little better request, with sales to day of 400 shares at $25.

Franklin dull but steady at $9¼@$9½. Osceola sold in a small way at $9¼. Kearsarge at $5. Allouez at 90c. Huron at $1¼. National at $1. Santa Fe at 75@70c. The aggregate of sales would not give one broker a fair commission for a week's work. We hope, however, to see ere long a change in this respect, and a more active market to gladden the hearts of the brokers and yield handsome profits to operators.

Silver stocks participate in the general dullness. Dunkin sold at $1.05. This company has declared its usual quarterly dividend of five cents per share, payable July 15th. Catalpa sold at 12½@13c., and ought to sell at 25c.

San Francisco. June 28.

A better feeling has ruled in this market, and there has been a general stiffening of values. Quotations by telegraph to the Consolidated Stock and Petrolium Exchange to-day were as follows: Best & Belcher, $2.90@$3; Bodie, $1.30@$1.35; Bulwer, 35c.; Cons. Cal. & Va., $7.50; Challar, $1.60@$1.70; Crown Point, $1.50; Commonwealth, $4.05; Eureka, $1.90; Gould & Curry, $2 05@$2.20; Hale & Norcross, $3.30; Mexican, $3@$3.30; Ophia, $4.35; Potosi, $1.50; Savage, $1.90@$2.05; Sierra Nevada, $1.95@$2.25; Union, $2.90@$3.30; Yellow Jacket, $2.85.

Baltimore, Md.

COMPANY.	Bid.	Asked.
Atlantic Coal	$1.00	....
Balt. & N. C.	....	.30
Big Vein Coal	....	....
Conrad Hill	....	.15
Cons. Coal	.22	.26
Diamond Tunnel	....	.50
George's Crk. C.	....	11½
Lake Chrome	....	....
North State (Balt.)	.20	.25
Ore Knob	....	....
Silver Valley	.40	.55

Prices bid and asked during the week ending June 27th.

St. Louis. June 26.

CLOSING PRICES.

	Bid.	Asked.
Adams, Colo	$ .31¼	$ .32½
Anderson, Mont	.12	.25
Arizona	.09	.10
Aztec, N. Mex	.37½	.40
Bi-Metallic, Mont	....	....
Black Oak, Cal	.35	.37½
Black Spar	.02	.02½
Bremen, N. Mex	....	....
Buckskin	....	....
Carriboo, Idaho	.13	.13½
Central Silver	.25	.27½
Cleveland, Colo	....	....
Concepcion, Mex	.08	.09
Dinero, Colo	.05	.06
Golden Era, Mont	.40	....
Golden King	.35	.38¾
Golden West	.75	1.10
Gold Run	.08	.08½
Granite Mountain, Mont	47.00	48.25
Hope, Mont	....	....
Ingram	....	1.50
Ivanhoe, Colo	.62½	....
I. X. L., Colo	.17½	.20
Jumbo, Colo	.08	.08½
Keystone	....	....
La Union	.03	.04
Little Giant	.17½	.18¾
Mary Foster, Colo	....	....
Major Budd, Mont	.22	.25
Mexican Imp., Mex	.45	.47½
Montrose Placer	.75	.90
Mountain Key	1.27	1.35
Neath, Colo	.17½	.25
Old Colony	.16¼	.20
Pat Murphy, Colo	.36¼	.37½
Phillips, Colo	.57½	.65
Queen of the West, Idaho	.20	.21¼
Rena	.03	.04½
San Francisco, Mont	.27½	.30
Small Hopes, Colo	1.35	1.65
Silver Age, Colo	5.40	6.00
Silver Bell	.26¼	.32½
Tourtelotte, Colo	.22½	.23¼
West Granite, Mont	.73¾	.75
Wire Patch	.25	.50
Yuma, Ariz.	.35	.40

Auction Sales of Stocks.

The following securities were sold at public auction in New York this week:

500 shares Cameron Iron and Coal Co	$25 lot
490 shares Stout Electric and Storage Battery C	16 "

Electric Stocks. June 28.

The following closing quotations are reported to-day by J. Heron Crosman, New York City:

Stocks.	Par value.	Market price.
Brush	$ 50	$65 @ $85
" Illuminating	100	70 @ 75
Daft	100	45 @ 55
Consolidated	100	65 @ 70
Edison	100	185 @ 190
" Illuminating	100	90 @ 95
Julien	100	20
" Traction	..	10 @ 13
United States	100	50 @ 60
" " Illuminating	100	50 @ 60
Westinghouse	50	45 @ 49½
Thomson-Houston	..	....
" " Welding Co.	..	....

Trust Stocks. June 28.

The following closing quotations are reported to-day by C. I. Hudson & Co., members New York Stock Exchange:

American Cotton Oil Certificates	$56⅛@ 56¼
Sugar Refineries "	115½@115¾
Distillers' & Cattle Feeders' Certificates	45⅛@ 45¾
Linseed Oil "	55½@ 56½
Natural Gas "	110 @120
Standard Oil "	168 @170
National Lead "	32¾@ 32½
Cattle Trust "	18⅞@ 19

During the week ending June 28th the following sales were made at the New York Stock Exchange:

	Sales.	Price H.	Price L.
American Cotton Oil Certificates	93,597	58⅞	55½
National Lead Trust	368,807	35	29⅞

PIPE LINE CERTIFICATES.

[Specially reported for the ENGINEERING AND MINING JOURNAL by WATSON & GIBSON.]

The oil market has been feverish and irregular, but with an increased volume of business and much greater confidence in values. Monday of this week furnished the trade with a sensation, and the transactions were nearly 5,000,000 barrels in the Consolidated Exchange, against 27,000 there last Saturday. The Stock Exchange was shown to be a farcical market for oil. They could not keep up with the procession. Oil was too lively for that institution, as reference to its sales list of Monday will show.

The market's antics were the resurrection, which our recent letters have said would come before long. The situation statistically as to Pennsylvania oil, which alone is dealt in on the exchanges, has been bullish all the time, but the market has been held in check by two considerations, to which we have often referred. First, the Ohio oil field, whose product is selling at about 20 cents per barrel, and which bears allegeance equal intrinsically to the Pennsylvania product. Secondly, to the theory that the Standard would hold the price down below 90 cents until after July 1st in order to force the Producer's to "put" to it the three and one-half million barrels, that the Producers also held the Standards "call" for at a lower price. The story to-day was that the Standard and Producers had settled, and that this consequently had removed the obstacle to an advance.

As the market has been stagnant for months the public were not in it, and had no oil to throw at it. There was a modest short interest based upon the dullness and the rivalry of Ohio oil, and as this was apparently larger in Pittsburg and the West than in New York, the price there rose to 101, or six cents higher than here. The close was feverish and uncertain, and, as the market is just getting out of its rut we would not like to hazard any opinion as to its immediate course, further than to say that the small stock of certificates will permit it to be easily bulled, and per contra, the existence of a large and prolific field at Lima, Ohio, which is almost exclusively owned by the Standard, might make it to this company's interest to break Pennsylvania oil and advance Ohio oil, until the two commodities could be united on a common level.

A new feature of trading in petroleum futures was introduced Thursday, and such business as was transacted in it was by the purely speculative fraternity. The *bona fide* holders of certificates, and the houses having the bulk of legitimate outside orders, are opposed to the plan, and we do not see how scalpers and small traders for a turn are going to conduct this market in face of the indisposition of the larger interests.

Purchases made to-day for July option may be delivered at the option of the seller either on the first day of July, or on any subsequent day up till the thirty-first. A purchaser of oil in this way might easily lose all the advantages which would come from any manipulation, ad interim, in the price of the actual certificates; and such manipulation, and such an appreciation in values, is certainly more likely to come from the capital which now owns the stock of oil above ground than from anything that a few speculative traders on the Exchange may be able to do on the shadowy and uncertain contracts for future delivery.

NEW YORK EXCHANGE.

	Opening.	Highest.	Lowest.	Closing.	Sales.
June 22	84	84	83¾	83¾	23,000
24	83¾	95	83¾	89¾	542,000
25	90½	91	89½	90¼	351,000
26	90	93⅜	89⅝	91⅝	609,000
27	91½	93	91⅜	92½	276,000
28	91¾	92¾	89¾	91⅜	590,000
Total sales in barrels					2,391,000

CONSOLIDATED STOCK AND PETROLEUM EXCHANGE.

	Opening.	Highest.	Lowest.	Closing.	Sales.
June 22	83⅝	83¾	83⅝	83¾	27,000
24	83⅞	95	83⅞	89⅞	4,910,000
25	91	91½	89⅝	90	1,187,000
26	90¼	93¾	89⅝	91⅝	2,465,000
27	91⅝	92¾	91⅝	92⅛	845,000
28	91⅞	92⅞	90⅜	91½	655,000
Total sales in barrels					10,089,000

COAL TRADE REVIEW.

NEW YORK, Friday Evening, June 28.

Statistics.

PRODUCTION OF COKE on line of Pennsylvania R. R. for week ending June 22d and year from January 1st, in tons of 2,000 lbs.: Week, 76,463 tons; year, 2,088,823 tons; to corresponding date in 1888, 1,858,432.

HUNTINGDON & BROAD TOP R. R. COMPANY.—The superintendent writes us that "owing to the railroad branches from the mines being badly washed out there has been no coal shipped from the Broad Top region since May 31st."

PRODUCTION OF ANTHRACITE COAL for week ended June 22nd, and year from January 1st.

Tons of 2240 lbs.	1889. Week.	1889. Year.	1888. Year.
P. & Read. R.R. Co.	141,181	2,761,699	2,501,201
Cent. R.R. of N. J.	140,840	2,504,916	2,351,827
L. V. R.R. Co.	175,000	3,284,296	2,612,121
D., L. & W. R.R. Co.	123,006	1,952,033	2,945,331
D. & H. Canal Co.	90,442	1,684,065	1,967,637
Penna. R.R.	63,798	1,531,005	1,968,192
Penna. Coal Co.	34,685	477,770	698,249
Penna. Canal Co.	10,000	152,862	145,780
N. Y., L. E. & W.	20,000	520,628	425,831
Total	798,952	14,869,274	15,616,769
Decrease		747,495	

The above table does not include the amount of coal consumed and sold at the mines, which is about six per cent of the whole production.

Production for corresponding period:

1884	13,628,406	1886	14,206,165
1885	12,754,639	1887	15,956,883

PRODUCTION OF BITUMINOUS COAL for week ended June 22d, and year from January 1st:

EASTERN AND NORTHERN SHIPMENTS.

Tons of 2240 lbs.	1889. Week.	1889. Year.	1888. Year.
Phila. & Erie R.R.	1,666	36,221	28,875
Cumberland, Md.	60,000	1,379,792	1,650,814
Barclay, Pa.	1,000	52,003	86,266
Broad Top, Pa.		162,370	180,494
Clearfield, Pa.	57,133	1,356,590	1,623,117
Allegheny, Pa.	7,180	395,513	385,374
Beach Creek, Pa.		591,467	699,890
Pocahontas Flat Top.	35,825	711,413	678,135
Kanawha, W. Va.	* 23,151	711,052	719,243
Total	185,955	5,397,421	6,052,208

*Week ending June 7th.

WESTERN SHIPMENTS.

Pittsburg, Pa	6,340	269,526	343,017
Westmoreland, Pa.	10,790	634,792	750,883
Monongahela, Pa.	11,916	131,518	170,060
Total	29,046	1,035,836	1,263,960
Grand total	215,004	6,433,257	7,316,168

Anthracite.

The event of the week has been the advance in prices which was ordered to commence on July 1st, and run through July and August. The new prices add 5 cents to grate, 15 cents to egg, 10 cents to stove and 15 cents to nut coal, making the new prices $3.90 for broken, $4.15 for egg and chestnut and $4.40 for stove coal. It is understood that early in August a further advance will be named to take effect September 1st, an advance which will put stove coal at $4.65, or add 25 cents a ton to the present figures.

At the meeting of the sales agents this week, at which this advance was ordered, the greatest harmony prevailed. Every one had decided that an advance should be made, and it was simply a question of how much. There can be little doubt that the advance, which it is in view to make on September 1st, will also take place according to the card. Consumers will do well to bear this in mind, and act in accordance therewith. The present prices are the lowest that we will have for the balance of this year, or at least until near the end of the year, and there is a prospect also that the freights on coal for Eastern shipment will later on be higher than they are at present.

The demand for coal at the new prices is, of course, merely nominal, but the June prices are now being obtained quite freely, and deliveries on June prices are actively pushed in view of the approaching increase to be made on coal delivered in July. It is true there is yet a considerable amount of coal sold in May for delivery through June and July, and this is being taken as rapidly as possible, for purchasers recognize that after the end of July no grace will be given them. The quantity of coal being mined is very large; in fact, it is too large, for the stocks of coal at tide water are increasing rather than diminishing, and at the end of May amounted to nearly one million tons. The scarcity of vessels is somewhat delaying deliveries; otherwise we might report the market as quite active on old orders, and with a fair demand for coal on new orders. This more particularly in the North and Northeast. The West still continues to drag, but there is some talk there also of ordering an advance in prices.

Mr. John H. Jones, Chief of Bureau of Anthracite Coal Statistics, furnishes the following statement of anthracite coal production for the month of May, 1889, compared with the same period last year. Compiled from the returns furnished by the mine operators:

	May, 1889.	May, 1888.	Difference.
From Wyoming Region	1,574,689	1,447,601	Inc. 127,088
From Lehigh Region	547,287	548,367	Dec. 1,079
From Schuylkill Region	894,554	855,501	Inc. 39,053
Total	3,016,531	2,851,470	Inc. 165,061

	For year, 1889.	For year, 1888.	Difference.
From Wyoming Region	6,357,812	8,541,891	Dec. 2,184,079
From Lehigh Region	2,289,628	1,330,530	Inc. 958,098
From Schuykill Region	3,466,544	3,305,384	Inc. 161,159
Total	12,113,985	13,177,806	Dec. 1,063,821

The stock of coal on hand at tide-water shipping points, May 31st, 1889, was 962,066 tons; on April 30th, 1889, 964,628 tons; decrease, 2,562 tons.

Bituminous.

There is little of importance to report in the bituminous coal trade. The large orders are mostly all closed, and the current business, while active, is not exciting much attention. Most of the mining districts have now a sufficient supply of cars, though we still hear some complaint from Cumberland, especially on the Pennsylvania Railroad Company's lines. Prices remain steady on soft coal, but they are independent of the old pool arrangement, which a good while ago was completely forgotten by most of the companies.

Generally, in the coal trade we anticipate a very lively demand and a large business for the months of August, September and October, with an increasing demand in July. There has been no such effort to stock coal this summer as we had last year, and it will leave a very large amount to be delivered in the last half of the year.

Boston. June 27.

[From our Special Correspondent.]

The anthracite market was thrown into a state of wild excitement and irritability to-day by the news of the advance. Store coal is marked up 10 cents, to $4.40; egg, 15 cents, to $4.15; broken, 5 cents (just enough to call it an advance), to $3.90, and nut, 15 cents, to $4.15; all the foregoing being f.o.b. at New York. These are merely nominal prices, the movement being made merely to enable the jobbers and agents to get orders at the old prices. Trade will certainly be dull for some days, but the anthracite producers have, by their past year's success, gained such prestige that the effect of this move will probably prove beneficial. Small sizes have improved a little. I hear of sales of buckwheat at $1.80. Pea and dust is quoted at $1.60. There is still considerable coal to come along on old orders, and I do not hear of these orders being cancelled.

Regarding bituminous coal, there are more orders than coal and more coal than vessels at all the shipping ports, and bituminous is not coming along very rapidly. Full f. o. b. prices are being maintained at $2.50@$2.60.

Vessels continue in light supply, quoting New York at 90 cents, with sometimes a lower rate on big vessels At Philadelphia rates range from $1.05@$1.25. Charter to Maine ports are at the lowest figure, because of the return cargo of ice. Baltimore rates are about $1 15@$1.20, and Hampton Roads, $1.05@$1.10.

The retail trade is getting into summer dullness. Prices remain unchanged and still afford a fair profit, as the combination continues to work to a charm.

Receipts are still rather light, noting 28,370 tons anthracite for the week and 9,081 tons bituminous. Since January 1st receipts have been 545,593 tons anthracite and 428,068 tons bituminous.

Buffalo. June 27th.

[From our Special Correspondent.]

The conditions of the anthracite and bituminous coal trade are unchanged. There is some talk of wholesale rates of anthracite being advanced July 15th, if not before. A retail dealer assured me that he had no reasons for believing that any variation would be made in the coal exchange schedule on the 1st of July, and further, he was satisfied that the present retail rates were high enough.

The Common Council made the award last Monday for the supply of coal for the Public Schools of our city to Mr. C. M. Underhill at his bid of $4.48 for grate and egg and $4 73 for stove and nut sizes per net ton delivered. This matter has been the principal topic of excited discussion among the trade and citizens generally for the past ten days and more. Mr. C. T. Hall's bid (3 cents less per ton) was deemed irregular and was thrown out by a vote of 12 to 9. The School Committee wrestled with the bids during the week, and counsel was employed by Mr. Hall. Much bad feeling was manifested, but as the story, if told in detail, would fill one of your pages, the brief announcement of the facts must suffice. What effect this schism will have upon the Coal Exchange remains to be seen; but I prophecy that nothing more will be heard of the matter from the fact that the great coal companies have the upper hand in determining whom to supply with fuel, the price, terms, etc.; and some satisfactory arrangement will be arrived at to settle the difficulty amicably, because there is certainly no doubt that the retailers have been greatly benefitted by the workings of the Coal Exchange despite the grumbling of the consumers against what they term a "wicked combination."

It appears that 1,500 to 1,800 tons of coal and about 100 to 150 cords of wood are used every year by the Poor Department, and the proposals or bids caused a great deal of amusement, "as they indicated," says a well-known citizen, "the efforts being made by the coal-ring men to get the best of each other despite the iron-bound injunction placed on each member of the Coal Exchange or combination not to cut prices."

The Niagara River & Erie Railroad Company has been incorporated; capital stock, $100,000. The route of the road, briefly stated, is as follows: commencing in the 12th ward of the city of Buffalo and terminating at the village of Tonawanda.

The Central Dock & Terminal Railroad Company has been chartered in New York and Pennsylvania by the officers of the New York Central and Philadelphia & Reading Railroad companies to build a line from its coal trestles in Georgia street, in this city, to the main line of the New York Central, for the purpose of facilitating the movement of cars laden with coal from the company's trestles now in progress of construction.

Vessel men had to accept another decline of 5c. on freights on coal to Chicago and Milwaukee, and about the same reduction to some other ports. The supply of tonnage offered has daily exceeded the demand, and many boats have left light or gone to other places for cargoes. The shipment of coal hence by lake from June 20th to 26th, both days inclusive, were light, aggregating 45,730 net tons, namely, 13,610 to Chicago, 11,800 to Milwaukee, 1,850 to Saginaw, 3,700 to Gladstone, 800 to Green Bay, 2,600 to Superior 310 to Algonac, 550 to Port Huron, 3,300 to Racine, 120 to Bay City, 250 to Amherstberg, 250 to Port Clinton, 1,010 to Sheboygan, 1,780 to Manitowoc, 2,800 to Ashland; total for season, 559,810 net tons, closing with evidences of improvement in demand and number of charters.

The rates of freight were 55@50c. to Chicago and Milwaukee; 50c. to Duluth and Portage; 50@40c. to Saginaw; 60c. to Racine and Ludington; 55c. to Manitowoc and Sheboygan; 45c. to Marquette and Ashland; 40c. to Alpena; 30c. to Port Huron; 25c. to Amherstberg; 50c. to Gladstone, Green Bay, Port Clinton, Superior and Agonac.

Shipments of coal by canal third week in June, 678 net tons; receipts, 5,622 net tons.

Pittsburg. June 27.

[From our Special Correspondent.]

Coal.—The only coal being mined at present is in the Fourth pool; the other three pools are on a strike. The coal men offer 2½ for mining, the other side wants 3 cents; that is the present situation; the price paid in Fourth for mining is 2 cents. The June shipment by the Ohio River were: For Cincinnati, 4,678,010 bushels; Louisville, 4,207,000. The run was a very successful one.

The nominal rates are:

PRICE OF COAL PER 100 BUSHELS = 7600 LBS.

First pool	$4.75	Fourth pool	$3.25
Second pool	4.50	Railroad coal	5.00@6.00
Third pool	3.90		

Connellsville Coke.—The improvement in the iron market has already been felt in the coke region, producing an active market which will likely be followed by an increase in values. Of the completed 13,311 ovens in the region, 10,751 are in blast; 2,660 idle previous week, 10,390 active; 2,917 idle. Week's production, 99,677 tons, against 93,752 tons previous week. Shipments 5,095 cars; previous week, 5,014 cars; increase, 81 cars.

Quotations as follows per ton:

Furnace coke	$1.05@$1.10	Crushed	$1.50
To dealers	1.10@ 1.15	Foundries	1.25

Freight rates from the ovens to Pittsburg, 70c. per ton; to Shenango Valley, $1.35; Cleveland, $2.80; East St. Louis, $3.50; Chicago, $2.75.

FREIGHTS.

The following rates per ton of 27,240 lbs. for coal charters are reported:

From New York to: Boston, $1; Bridgeport, .55; East Boston, 1.00*; Fall River, .75; Lynn, 1.15*; New Bedford, .75*; New Haven, .55; New London, .60*; Newport, .60*; Norwich, .55; Norwalk, .5?; Portland, 1.00*; Portsmouth, N. H., 1.10*; Providence, R. I., .75; Quincy Point, 1.00*; Sag Harbor, .85*; Salem, Mass., 1.00.*

From Philadelphia to: Bath, Me., 1.15*; Baltimore, .60; Boston, 1.10@1.20*; Charleston, .90; Chelsea, 1.20*; East Cambridge, 1.15*; Fall River, .80@.90*; Georgetown, D. C., .85†; Gloucester, 1.10*; Lynn, 1.15*; New Bedford, .80@.90; Newburyport, 1.15@1.20*; New York, .90†; Norfolk, Va., .55; Portland, 1.10*; Portsmouth, N. H., 1.15*; Providence, .80@.90*; Richmond, Va., .60; Salem, 1.05; Savannah, .90; Washington, .85.†

From Baltimore to: Bangor, 1.25; Bath, Me., 1.25; Boston, Mass., 1.15; Bridgeport, 1.05; Charleston, .80; Fall River, 1.05; Galveston, 3.00; New Bedford, 1.05; Newburyport, 1.40; New Haven, 1.05; New London, 1.05; New York, 1.00; Portland, 1.15; Portsmouth, N. H., 1.20@1.25; Providence, 1.05; Quincy Point, 1.15; Richmond, Va., .70; Salem, Mass., 1.15; Savannah, .90; Somerset, 1.15; Williamsburg, N. Y., 1.00; Wilmington, N. C., 1.00.

* And discharging. † Alongside.

METAL MARKET.

NEW YORK, Friday Evening, June 28, 1889.

Prices of silver per ounce troy.

Jun.	Sterling Exch'ge.	Lond'n Pence.	N. Y. Cts.	Jun.	Sterling Exch'ge.	Lond'n Pence.	N. Y. Cts.
22	4.88½	42	91⅞	26	4.88½	42 1-16	92
24	4.88½	42 1-16	92	27	4.88	42	91⅞
25	4.88½	42 1-16	92	28	4.87¾	42	91⅝

Silver has been dull this week, with weaker tendency. Council bills declined ⅛d. per rupee on last Wednesday's allotment. Tighter money here has caused lower exchange, which has also depressed price of silver.

Silver shipments to London have been lighter than usual this month.

United States Assay Office at New York reports total receipts of silver for the week 37,000 ounces.

Foreign Bank Statements.

The governors of the Bank of England at their weekly meeting made no change in its minimum rate for discount, which remains at 2½ per cent. During the week the bank gained £361,000 sterling bullion, and the proportion of its reserve to its liabilities was raised from 43·53 to 43·75 per cent, against an advance from 42·75 to 43·26 per cent in the same week last year, when its rate of discount was 2½ per cent. The weekly statement of the Bank of France shows a gain of 26,682,000 francs gold and a gain of 2,300,000 francs silver.

Domestic and Foreign Coin.

The following are the latest market quotations for American and other coin:

	Bid.	Asked.
Trade dollars	$ .72	$ —
Mexican dollars	.73	73½
Peruvian soles and Chilian pesos	.72½	.73½
English silver	4.85	4.89
Five francs	.94	.95
Victoria sovereigns	4.87	4.89
Twenty francs	3.90	3.93
Twenty marks	4.75	4.80
Spanish doubloons	15.60	15.75
Spanish 25 pesetas	4.80	4.85
Mexican doubloons	15.55	15.70
Mexican 20 pesos	19.50	19.65
Ten guilders	3.96	4.00

Copper.—All reports agree that the deliveries of both Lake and casting brands are very heavy. Prices remain unaltered since a week ago. Lake being still quoted at 12c., and casting at 10⅝-¾c. for lots of 25-000 pounds, and about ¼c. more for retail quantities

Consumption is evidently going on at a very brisk rate, and it is a fact that manufacturers all around are well booked with orders for a considerable time forward. Some more Lake copper has again been shipped to Europe during the past week, part of such exports being made by the agents of one of the large banking firms in Europe, known to have backed the late syndicate to a considerable extent.

In furnace material offerings are light and the holders are still very firm.

The London Market for Chili bars and G. M. B. has been rather erratic during the week, and on heavy selling by one firm of dealers, prices which opened on Monday morning at £41 10s. to £4112s. 6d. spot and £41 5s. £41 7s. 6d., 3 months, declined on Wednesday to £40 to £40 5s. spot and £39 10s. to £39 15s., 3 months, afterwards recovering somewhat, however, and closing to-day at about the same price as Monday's opening quotations. Mail reports from Europe continue in the same hopeful tone as previously noticed, and we quote English tough copper £45 10s. to £46; best selected, £47 to £48; strong sheets, £53.

It is expected that the total deliveries for the second half of this month will again prove very satisfactory.

The exports of copper from New York during the past week were as follows.

		Copper.	Lbs.	
To Havre—				
By S. S. La Normandie	.100 casks		125,000	$15,000
" " " "	90 "		112,500	13,500
To Hamburg—		Copper Matte.		
By S. S. Gillert			195,700	13,775
		Copper Bullion in Transit.		
" " "	16 bars		1,001	1,800
		Swnps in Transit.		
" " "	2 bbls.		1,291	800
To Liverpool—				
By S. S. Saint Ronaud	6,069 sacks		675,964	30,100
" " City of Chester	176 bbls.		185,728	7,500

Tin.—This market has been the subject of large fluctuations during the week, having pretty closely followed the movements in London, where on Monday last prices opened at £88 7s. 6d. to £88 12s. 6d. spot, and £88 12s. 6d. to £88 17s. 6d. futures, declining that day to £87 17s. 6d. to £88 spot and £88 12s. 6d. to £88 15s. futures, and improving again on Tuesday about 10s. and on Wednesday about £1 more, and afterwards hardening still further and closing this afternoon at £89 7s. 6d. to £89 10s. spot, and £90 to £90 2s. 6d. futures. Consumers orders are coming in very freely, and nearly all the recent rather heavy arrivals in this country have at once gone forward to consumers, very little indeed going into store. Our closing quotations are: Spot, 20; July, 20; August, 20·10.

Lead.—The firm tendency lately noticed has continued and become more pronounced, and as very little metal is offered, prices have further advanced. Sales have been made for July and August at 4·05, and now 4·10 to 4⅛ is asked, but at these prices consumers are holding off somewhat, and business during the last few days has been rather quieter. As, however, there is very little lead in the market, in order to effect purchases buyers have now to pay the figures just named.

The Chicago Market.—Messrs. Everett and Post telegraph us to-day as follows: For the past week this market has been strong and very active at higher prices. Since the opening over 1,000 tons have changed hands, mostly at 3·87½@3·90c. Consumers have looked for a change in the Treasury ruling on Mexican lead ores, hence the large sales. At the close, market is less active, but firm at 3·90c.

The St. Louis Market.—Messrs. John Wahl & Co. telegraph us to-day as follows: The market here continues very strong. Since our last report prices have further advanced, and sales have been made at 3·8c. There is a steadily increasing demand, sales for July being made at 3·85c. Sales for the week aggregate from 400 to 500 tons at from 3·75 to 3·85c.

Spelter continues very firm, but no new business is reported.

Antimony is again very much higher in price. The European producers have now put their prices up to £64 for Hallett's, which is in the parity of 15¼ here. Quotations here are now 15@15⅛ for Hallett's, and 16½ for Cookson's. The metal is so very scarce that it is thought prices may yet go a good deal higher.

IRON MARKET REVIEW.

NEW YORK, Friday Evening, June 21.

Pig-Iron.—A better feeling undeniably rules in this market and while there have been no particularly large sales during the week, we learn from various sources of sales aggregating about 5,000 tons. In some quarters, however, there seems to be a disposition to substitute sensational rumors for reports of actual sales. For instance, the interesting statement has been made that the Tennessee Coal, Iron and Railroad Company through Messrs Naylor & Co., its New York agents, have closed a contract for five hundred thousand tons of pig-iron, for delivery during a period of three years, to a syndicate of Pittsburg rolling-mill owners. As might be expected, however, from the strong evidences of improbability which such a rumor bears on its face, Messrs. Naylor & Co. authorize us to emphatically deny that any such contract has been entered into. Another report, more or less fanciful, is to the effect that a syndicate has been formed by a number of New York speculators to buy up one hundred thousand tons of iron and that thirty thousand tons of this amount have already been secured. Whether or not these statements are intended solely for "boom" purposes, or whether, at the first indications of an improvement, some of our iron dealers have allowed their imaginations to become overheated, it is as yet impossible to say; but it is at all events certain that the circulation of such stories as these, unless they are capable of prompt verification, is liable to create distrust in all statements of an encouraging nature, and will prove a "boomerang" rather than a "boom." Prices are not quotably changed. We continue to quote Northern irons as follows: No. 1, Foundry, $16.50@$18.00 at tidewater, depending upon brand and seller; No. 2, $15 50@$16.50; Grey Forge, $14.50 @$15 50. Southern iron is now quoted at $16.50@ $17.50 for No. 1: $15.50@$16.00 for No. 2; $14.75 for No. 3, and $14.50 for Grey Forge.

Wire Rods.—Very little business has been done. We continue to quote $43 ex ship.

It is announced that the Thomas Iron Company will next week advance the price of iron for July and August delivery 50 cents a ton for Nos. 1 and 2, to $17 and $16 respectively. President Clarke says: "We have shipped more iron in May and June than ever before in any two months in the history of the company. We have 10,000 tons less foundry iron on hand now than last year, and on July 1st we will not have a pound. I expect to sell the whole product of the furnaces this year. We have orders enough for steel rails to last until next January. Our price is $28 at the mill, firm. At the New Jersey Zinc and Iron Works we shipped more zinc in May and June than ever before."

Another evidence of the improvement in the trade is the sale by the Cameron Coal and Iron Company of 500 tons of No. 2 pig iron at 70 cents above the price quoted by the Thomas Iron Company.

Scotch Pig.—The only animation that can be recorded in this market is in small lots for current needs of consumers. In this way several hundred tons have been sold during the week. Ruling quotations are as follows: Dalmellington, $19@50; Summerlee, $21 50; Shotts, $21; Langloan, $21; Coltness, $21.50.

Spiegeleisen.—From $28 to $28.50 is the usual quotation for twenty per cent. speigeleisen, either English or German. At these figures, business has been light. Ferromanganese, 80 per cent, is steady at $60, and a number of small lots have been disposed of at this price by leading importers.

Steel Rails.—Sales of 3,000 tons are about all that can be definitely recorded this week. All the mills, both East and West, affirm that they are sold well up for a few months to come and at all points there seems to be a disposition to adhere firmly to the quotation of $28 per ton at Eastern mills. Sellers are very confident that the long-expected turn of the tide is now well under way and that prices will regain their normal basis. At this time last year, during a period of intense political agitation when business is invariably dull, rails were held at $30 at Eastern mills and at $31 in Pittsburg.

Structural Iron and Steel.—There has been less activity this week than usual. Prices, however, are generally maintained.

Plates.—A steady demand of more than moderate volume is reported. Prices for round lots remain as given in our usual list, although efforts are being made to obtain a small advance. It is worthy of note that the use of flange iron is greatly decreasing, steel flange having taken its place very much the same as steel has been substituted for iron in the composition of rails. For the latter 3·75c. is asked, while the former may be obtained at 2·8c.

Bar Iron.—A free movement from store is uniformly reported. We quote at mill, common, 1·6c., and refined, 1·7c. On dock, common is held at 1·7c., and refined at 1·9c.

Merchant Steel.—Business has been confined principally to small lots during the week. Bessemer spring and machinery is offered at 2½c., crucible spring is quoted at 3¾c., and crucible machinery at 5c.

Scrap Iron.—No. 1 wrought scrap is quoted at $20, and cast scrap at $12 to $14 according to quality.

Old Iron Rails can be bought at $22 tees and $23 for doubles. Holders are endeavoring to obtain $23 for tees.

Old Car Wheels are held at $18. Several buyers have been in the market but we can learn of no actual transactions.

Wrought Tubes are in good demand. As noted last week the discount on boiler tubes has been reduced to 60 per cent.

Reduced Rates on Iron Shipments.—Under date Chicago, June 22d, a dispatch from Cleveland, O., says: "Rates on iron from Cleveland to the East were reduced again yesterday in proportion to the cut from Youngstown and the Mahoning Valley. The rate on pig-iron to New York goes down from $3.50 to $2.80 for car lots. On manufactured iron the reduction is from 17½ cents to 14 cents on car lots, and from 21½ to 17½ cents on less than car lots.

Duty on Ferro-silicon.—An appeal was recently made to the treasury department from the decision of the Collectors of Customs of Chicago assessing duty at the rate of three-tenths of a cent per pound on certain imported ferro-silicon. The appellants claim that the article is not the pig-iron of commerce, but is a metal composed of iron and silicon, and is used by manufacturers to melt with pig-iron, and it is therefore entitled to entry at the rate of 20 per cent ad valorem under the provision for metal unwrought, not especially provided for.

The appraiser reports that the article is ordinary pig iron, containing about 10 per cent of silicon, and is used in mixing with low grades of pig-iron to increase the percentage of silicon, thereby strengthening the product, and that its value is about one third more than the ordinary pig-iron.

The department has decided that the fact that the article contains a larger proportion of silicon than ordinary pig-iron does not remove it from the category of pig-iron and has affirmed the decision of the collector. That officer has been informed that the distinction between ferro-silicon and chrome pig-iron lies in the fact that chrome pig-iron is made from a combination of iron and chromic ores, while ferro-silicon is made from a single ore, which, however, contains both iron and silica.

Cleveland. June 26.

[From Our Special Correspondent.]

There has been increased activity in the ore market during the past week. Probably 75,000 or 100,000 tons in all were contracted for, one company alone reporting sales of 25,000 tons. The officers of two furnace companies, the Tonawanda Iron and Steel Company, of Tonawanda, and the Ohio Iron Company, of Zanesville, spent most of the week in town buying in their ore supplies for the season. There are still many other furnaces who have bought very sparingly, and must come into the market before long. Lake freights are easier but with no change in rates, viz, from Ashland and Two Harbors, $1.25; from Marquette, $1.10; from Escanaba, 90c., all to Lake Erie ports.

We repeat quotations of last week:

SPECULAR AND MAGNETIC ORES.		
Bessemer, 66 to 69 per cent		$5.50@$6.25
" 60 to 64 "		4.50@ 5.50
Non- " 66 to 69 "		5.00@ 5.25
" " 62 to 65 "		4.25@ 4.75
" " 57 to 60 "		3.75@ 4.00
SOFT HEMATITES, DRIED AT 212°.		
Bessemer, 62 to 65 per cent		$4 50@$5.00
" 59 to 61 "		4.25@ 4 50
Non- " 57 to 62 "		3.50@ 4.25

Above prices are delivered on docks at Lake Erie ports.

Louisville. June 25.

[Special Report by Messrs. HALL BROTHERS & Co.]

Several inquiries were made and sales closed for round quantities during the past week, though buying has not been general. One sale of 2,000 tons of mill iron was made at a price equal to $13.50 cash at Louisville. A few Southern furnaces anticipate better figures, while some Northern ones are offering iron at still lower figures. One day the situation looks brighter, but the next day's canvass would disclose sales at lower prices than ever, so it may be said that, with the exception of a few round orders, the market remains practically the same.

Quotations which are per cash f.o.b. cars will be found in our weekly register of prices.

Philadelphia. June 28.

[From our Special Correspondent.]

Eastern Pennsylvania pig-iron makers are anxious to capture as much business as possible at present strong quotations. They prefer doing this to holding back for the purpose of securing an uncertain advance in August. There is a great deal of talk about an advance of 25 cents to 50 cents and such advances are being paid by a good many, but most of them are small buyers. A large amount of business is still being done at low rates, although the fact is not admitted by brokers or makers. They are giving it out that prices are up fifty cents for certain, and that this will be maintained not only on first-class irons but on ordinary and inferior brands. Trade conditions are decidedly better than they were a week ago. A careful inquiry shows that there are more buyers in the market, much more iron selling and a great many inquiries. The consumption of iron will steadily advance during the months of July and August at least. Rumors are rife to-day of certain concessions being privately made to large buyers; on the other hand there are rumors that an advance will likely be made on choice and special brands of iron. It is not known, and the fact cannot be dug out, that any large sales have been made at the rumored advance. The substance of the whole thing is that both mill and foundry are still under a good deal of uncertainty, as buyers do not know whether it would be wise to let this month glide by without booking their orders or not. Iron reports from all other centers are read and criticised closely. Our eastern consumers are not quite satisfied that the strong upward tendency will likely endure. They argue that the possibilities of the inroads of Southern iron will guard them a first any great advance. While this is true there are enough in the market this week buying iron to maintain the upward tendency. Within the past two or three days a great deal of first-class foundry and forge iron appeared for immediate delivery, but the bulk for delivery during the summer months. Mill owners have been booking a good deal of business, and at figures which enabled them

to pay a slight advance. The failure of S. Robbins & Sons was announced two days ago, total liabilities, $115,000. The company built a blast furnace some years ago which was never a paying concern. Some few bloomeries have put prices up, but it is a question whether they are getting the advance. A good many old contracts are out for a month or two to run, so that the advance will not benefit the trade much. A further advance has taken place in muck bars, and there are two or three makers now asking $29. Mills are rapidly filling up. Several large contracts have just been placed for skelp iron, and some makers of pipe have contracted for large lots of Southern pipe iron. How much not known. Some Western bar iron has been arriving in Eastern markets, contributing still farther to the unsettled condition of the market. None but the smaller buyers are paying the advance asked. Yesterday and to-day a good many large buyers placed contracts for July delivery. It now seems probable that a general advance will be made as the mills are filling up. Mill owners generally are anxious to secure a good deal of business before enforcing an advance. An advance of 10 cents is being maintained on small lots. The country nail trade is quite heavy. Large lots are being shipped into middle Pennsylvania. The wrought-iron pipe makers are picking up a good deal of business Discounts are well maintained on pipes and tubes. A full summer's business is in sight. The makers of light sheets and galvanized report a very active demand during the past three or four days. There is no scarcity or trouble about obtaining business at card rates. Parties who have large lots to place find it impossible to find the desired concessions, and are therefore breaking their orders up into small ones. The excellent condition of things is reported as continuing in the plate iron mills. Quoted rates are now selling rates on all small lots. To-day we hear of several contracts which will probably be on the market next week. The owners of structural iron are finding it no easy matter to place orders for within sixty days. Manufactured iron makers are anticipating a slight advance. The most active inquiry at present is for bridge plate. Some Western bridge builders are likely to be in the market soon for some exceptionally large lots. It is intimated that ship building requirements this fall will be unusually heavy. Steel rails are stronger than they have been for some months, and are now quoted at $28, but brokers who have attempted within the past few days to place orders for large lots claim that they can do better than that figure. Makers are endeavoring to maintain $28 as a bottom figure. The demand for old rails has fallen, and there are very few inquiries at present, although there would be no trouble in selling a good many rails at buyers' terms. Southern roads who have been solicited to take up their old iron rails do not care to do so at present, as they believe that year by year the price will improve. There is a scarcity in scrap in local markets. A liberal supply is promised during July. Dealers are scouring the country for stock, and expect to be able to meet all requirements at quoted rates. In the smaller shops and factories throughout the State labor is well employed, and the indications are that the fall months will be busy ones.

Pittsburg. June 27.

[From our Special Correspondent.]

The raw iron market presents healthy indications. The gradual and regular improvement we have noted the past two weeks continues, while there has been no "big boom." There has been a larger number of buyers, who in many cases have paid the advance demanded. The movement towards higher prices continues. Of course, buyers do all they can to resist the advance without meeting with much success. Many of them are anxious to lay in a good supply at previous prices. On the the other hand, sellers are showing a good share of liberality nevertheless, and at the same time are securing an advance on most descriptions of iron. The Thomas Iron Company have advanced pig iron 50 cents per ton, to go into effect at once. Their price before the advance was fully $1 per ton above Pittsburg prices. Forge irons seems to be the most fancied at present. A furnace man reported a sale of 1,000 tons gray forge at $14 cash, declining an offer for 2,000 tons additional at the same figure, preferring to wait and take the chances of the market. We know of an offer of $13.60 at a valley furnace for 2,000 tons grey forge, the owner refusing to accept less than $13.75. Freight to Pittsburg, 65 cents, making the cost delivered here $14.40. Less than three weeks ago the same metal was offered at $13.25. These are simply facts, and show distinctly the situation of the market. In regard to the Amalgamated scale nothing has yet been done. The report that manufacturers had signed was purely imagination. There are two opinions current—both different. The scale may be altered and signed, and there may be a strike.

Coke and Coal Smelted Lake Ore.

2500 Tons Gray Forge	13.90	cash.
1500 Tons Bessemer	16.00	cash.
2000 Tons Bessemer	16.50	cash.
1000 Tons Gray Forge, July	14.15	cash.
1000 Tons Gray Forge, Spot	14.15	cash.
1000 Tons Gray Forge	14.00	cash.
2000 Tons Gray Forge	13.90	cash.
100 Tons Bessemer	16.20	cash.
1000 Tons Gray Forge	14.00	cash.

Coke, Native Ore.

1,000 Tons Gray Forge	14.00	cash.
200 Tons Gray Forge	14.00	cash.
50 Tons No. 2 Foundry	15.00	cash.
60 Tons No. 2 Foundry	15.00	cash.
100 Tons No. 2 Foundry	15.00	cash.

Muck Bar.

1,500 Tons Neutral, to go East	26.70	cash.
1,200 Tons Neutral, delivered East	28.50	cash.
1,000 Tons Neutral, July, Phila. district	28.85	cash.

Steel Slabs and Billets.

2,000 Tons Billets	28.00	cash.
1,500 Tons Billets and Slabs	28.00	cash.
500 Tons Billets and Slabs	28.25	cash.
500 Tons Billets and Slabs	28.00	cash.

Bloom Ends.

500 Tons Bloom Ends, July	18.00	cash.

Ferro-Manganese.

120 Tons 80 per cent	61.25	cash.

Skelp Iron

500 Tons Wide Grooved, per 500 lbs	1.67½	4 mo.
500 Tons Wide Grooved, per 500 lbs	1.70	4 mo.
500 Tons Narrow Grooved, per 500 lbs	1.65	4 mo.
500 Tons Sheared, per 500 lbs	1.90	4 mo.

Old Iron Rails.

1,200 Tons American Ts	22.25	cash.

CHEMICALS AND MINERALS.

NEW YORK, Friday Evening, June 28

Heavy Chemicals.—The demand for chemicals of this class is still very light, and, with the exception of a little business in small lots for immediate consumption, there has been little or no activity during the week. Prices are not notably changed, although, as noted last week, importers are endeavoring to secure an advance.

Supplies on the spot in most quarters are light. Foreign advices are a little firmer in tone. Makers on the other side are not pressing the market so severely, but whether or not, the actual condition of the Liverpool market is any better than before it is as yet impossible to determine.

Caustic soda is held at 2·15c. for all the higher tests, 70, 74 and 76 per cent in large quantities. For 60 per cent the nominal quotations are 2·37½@25c.

Bleaching powder has been weak in price, with scarcely any demand. We quote more or less nominally, 1·45@1·5c. Jobbing lots are held at 1·75c. The importers who, at the beginning of the year, contracted ahead for "bleach" are now in an unenviable frame of mind. We understand that an out-of-town house, having offices in this city, has recently resold several lots of bleaching powder in Liverpool before shipment. They were, of course, obliged to do so at a loss, but it is thought that they would have lost more had they imported it and endeavored to find a buyer for it in this market.

The following from an English contemporary will be of interest to those engaged in the production or sale of bleaching powder: "Mr. Charles Lever, of Altrincham, has succeeded in producing direct from natural brine, by means of electricity, bleaching powder, caustic soda, and a solution to be used in bleaching the finest and most delicate fabrics. This discovery is likely to have the effect of revolutionizing the manu-

IMPORTS AND EXPORTS OF METALS AT NEW YORK JUNE 15 TO JUNE 22, 1889, AND FROM JANUARY 1

IMPORTS.

Spelter.	Week. Tons.	Year. Tons.
Amer. Metal Co		67
Downing & Co., R.F.	28	28
Hendricks Bros		28
Lamarche's Sons, H.		6
Naylor & Co		205
Total	28	334
Corres. date, 1888	28	1,162
Nickel.	Lbs.	Lbs.
McCoy & Sanders		11,240
Total		11,240
Antimony.	Casks.	Casks.
Total		1,358
Corres. date, 1888	100	1,561
Pig Lead.	Lbs.	Lbs
Caswell, E. A		10
Erie Dispatch		9
Foley, E		43
Henderson Bros		11
Hendricks Bros		67
Total		140
Corres. date, 1888		100
Tin.	Tons.	Tons.
Amer. Metal Co		481
Bidwell & French		450
Bruce & Cook		14
Carter, Hawley & Co		45
Cohn & Co., A		12
Crooks & Co		172
Daval & Son, John		21
Hendricks Bros		128
Knauth, N. & Kuhne		10
Lehmarer, S. & Co		97
Mendel & Tompkins		1
Muller, Schall & Co		917
Naumann, F		1
Naylor & Co		1,166
Phelps, Dodge & Co		1,597
Pope, J. E., Jr		225
Schmarer & Co		11
Thomsen, A. A		151
Thomsen, D		156
Townsend, J. R		135
Wheeler & Co		1
Total		5,828
Corres. date, 1888	199	6,757
Tin Plates.	Boxes.	Boxes.
American Metal Co		44
American Metre Co		405
Brown & Co., V. H		350
Bruce & Cook	99	48,911
Byrne & Co., J		8,392
Central Stamp. Co	3,041	51,644
Coddington & Co	3,227	89,831
Cohen, S. M		272
Cohn & Co., A	1,978	11,260
Con. Fruit Jar Co		786
Cort & Co., N. L	4,861	81,978
Corbier, F. & S	450	3,694
Crooks & Co	1,334	53,494
De Milt & Co	380	19,880
Dickerson, V. D	7,603	186,269
Downing & Co		366
Erie Dispatch		244
Foley, E		39
G. L. N		75
Holder & Herrick		271
Iron Clad M. Co		283
Ismay, J. B		500
Lalance & G	52	6,207
Lazard Bros		2,356
Lombard, Ayres		3,000
Merchant & Co	526	10,153
Mersick & Co		6,016
Morewood & Co		7,030
Mulholland & H		767
Newell Bros		294
Payne & Son		208
Phelps, Dodge & Co	19,046	338,701
Pratt Mfg. Co	7,037	121,333
Wolff & Reesing		3,106
Sanders Bros		479
Shepherd & Co	202	15,187
Somers Bros		1,048
Taylor Co., N. & G		322
Thomsen, A. A	100,095	111,021
Warren & Co., J. M.	100	3,534
Wheeler & Co	279	11,688
Whittemore & Co	190	19,100
Wolff & Reesing		2,532
Total	150,779	1,291,679
Corres. date, 1888	46,028	918,626
Pig Iron.	Tons.	Tons.
Bartlett, N. S		900
Crocker Bros	100	3,893
Crooks & Co		500
Drummond, McC. & Co.	300	600
Henderson Bros		166
Godwin & Son, A. G		390
Irvin & Co., R		150
Martin, W. T		150
Naylor & Co		50
Page, Newall & Co		75
Perry & Ryer		125
Pierson & Co		500
Pope, J. E., Jr		250
Sheldon & Co., G. W		200
Stetson & Co	150	3,650
Walbaum & Co		275
Whittemore & Co., H		50
Williamson & Co		1,800
Total	350	13,574
Corres. date, 1888	1,540	26,286
Steel Sheets, Billets, Forging, etc.	Tons.	Tons.
Abbott & Co		2,450
Ames, W. T		253
Baldwin Bros. & Co		15
Belcher, H. W		95
Boker, C. F		131
Carey & Moen		118
Carter, G. F		200
Coddington & Co		24
Crenshaw, Hugh		27
Crooks & Co		292
Cortis, R. J		408
Curran, J		5
Dana & Co	500	11,705
Downing & Co		171
Erie Despatch		40
Galpin, S. H		497
Hugill, Chas		95
Ismay, J. B		174
Lalance, & G		106
Lazard Bros		6
Leng's Sons, J. S		114
Lublin & Estey		7
Lundberg, G		51
Mersick & Co		5
Milne & Co		1,557
Montgomery & Co		5
Naylor & Co		2,710
Newton & S		35
Oelrich & Co		389
Pierson & Co		323
Pilditch, F. S		75
Power, C. W		36
Prosser, Thos		496
Roebling's Sons		112
Schulze & R		13
Standard Oil Co		222
Stetson & Co		11
Strouse & Co., M		25
Temple & L		15
Wagner, W. F		373
Wallace & Co		5
Wetheral Bros		2
Whitney & W		30
Wiel Elie		44
Wiell & Co		7
Williams & W		95
Wolff, R. H		347
Total	500	23,926
Corres. date, 1888	1,899	16,424
Bar Iron.	Tons.	Tons.
Abbott & Co., J		1,017
Bacon & Co		307
Downing & Co		519
Holt & Co., H. N	74	74
Jacobus, E. G		17
Lundell, C. G	160	160
Merchants' Dispatch	15	15
Milne & Co		360
Muller, Schall & Co		575
Naylor & Co		186
Ogden & W		7
Page, N. & Co	50	986
Plenty, John		2
Troment, F		440
Wells, F., & Co		15
Total	50	4,585
Corres. date, 1888	197	2,143
Steel and Iron Rods.	Tons.	Tons.
Abbott & Co., J		2,154
American S. Co		701
Bacon & Co		256
Boker, H		20
Bruce & Cook		20
Carey & Moen		566
Cooper, H. & Co		40
Crabb & Co., W		17
Dana & Co		1,915
Downing & Co		690
Durbrow, Walter	100	320
Fuller, D. & T		15
Galpin, S. H		1,057
Hazard Mfg. Co		20
Heyn, A	400	1,754
Lillenberg, N		56
Lundberg, G		56
Lundell, C. G		246
Milne & Co		592
Montgomery & Co		36
Muller, Schall & C		378
Naylor & Co	157	9,418
Nichols, B. J		10
Oelrichs & Co		50
Page, N. & Co		574
Pratt Mfg. Co		30
Roebling's Son		1,144
Wheeler & Co., E. S		120
Whitney & Co		580
Williams & W		5
Wolf & Co	25	3,330
Wright P. & Co		3
Total	682	26,943
Corres. date, 1888	2,021	31,100
Old Rails.	Tons.	Tons.
Baldwin Bros. & Co		240
Bowring & A		57
Crossman & Bro		1,298
Henderson Bros		150
Neumark & Gross		6,115
Perkins, C. L		433
Perry & Ryer		177
Sheldon & Co		203
Ward & Co., J. E		21
Total		8,664
Corres. date, 1888	509	5,541
Scrap Iron.	Tons.	Tons.
Burgass & Co		162
Downing & Co		321
Funch, E. & Co		397
Neumark & Gross		500
Spaulding & Co		172
Ward & Co., J. E		429
Watjen, F. & Co		152
Total		2,133
Corres. date, 1888		1,398
Sheet Zinc.	Lbs.	Lbs.
Crooks & Co		441,814
Lemarch's S'ts, H		1,554
Total		443,368
Sheet Iron.	Tons.	Tons.
Coddington & Co		456
Downing & Co		16
Kelly, Hugh		5
Total		477
Corres. date, 1888	31	1,145
Charcoal Iron.	Tons.	Tons
Bacon & Co		97
Downing & Co		671
Lilienberg N		6
Milne & Co		94
Muller, S. & Co		135
Naylor & Co		45
Page, N. & Co		754
Total		1,802
Spiegeleisen.	Tons.	Tons.
Abbott & Co		2,176
Blakely & McLellan		3,100
Crocker Bros	300	7,579
Dana & Co		5,676
Farris & Co		325
Geisenheimer & Co		85
Jansen, J. A	327	9,327
Naylor & Co	350	9,080
Perkins, C. L		1,401
Walbaum Bros		675
Total	977	39,897
Corres. date, 1888	250	19,499
Iron Ore.	Tons.	Tons.
Earnshaw, A		4,971
Lawrence, Johnson & Co		480
Total		5,451
Corres. date, 1888	1,357	17,797

EXPORTS.

Copper.	Pounds.	Pounds.
Abbott & Co		463,109
Amer. Metal Co		699,527
Am. & Patterson	11,250	66,250
Hurst, F. W. J		113,000
Naylor & Co		1,234,500
Orford, C. & S Co		112,013
Piper, D. & Co		3,898
Seaman, Sam'l H		141,800
Total	11,250	2,834,097
Corres. date, 1888	474,536	21,425,333
Copper Matte.		
Abbott & Co		427,613
Amer. Metal Co		3,219,598
Am. & Patterson		198,500
Clark, W. A		879,019
Henriott, F	9,991	50,293,260
Seaman, Sam'l H		13,000
Wil'ms, Terhune		1,398,094
Total	9,991	11,219,082
Corres. date, 1888		
Copper Ore.		
Burgass & Co		32,160
R. J. Cortis		34,100
Total		66,560
Corres. date, 1888		181,698

CURRENT PRICES.

These quotations are for wholesale lots in New York.

CHEMICALS AND MINERALS.

Acid—Acetic, ₱ 100 lbs..... 2.00
Muriatic, 18°, ₱ 100 lbs ... .. 1.10@1.20
Muriatic, 20°, ₱ 100 lbs..... 1.35@1.50
Nitric, 36°, ₱ 100 lbs..... 4.00@5.50
Nitric, 42°, ₱ 100 lbs..... 5.50@7.00
Oxalic, ₱ 100 lbs..... .9.50@10.50
Sulphuric, 60°, ₱ 100 lbs. ..... 90@95
Sulphuric, 66°, ₱ 100 lbs ..... 95@1.25

Alkali—36 p. c..... 1.20 @1.25
Refined, 48 p. c .....1.22½@1.25
Refined, 58°..... .....1.15@1.20

Alum—Lump, ₱ lb..... 1¾
Ground, ₱ lb.. ..... 1¾@2
Lump ₱ ton, Liverpool £4 17 6
Sulphate of Alumina, ₱ ton.....£4 10

Aqua Ammonia—18°, ₱ lb..... 4¾
20°, ₱ lb..... 6
22°, ₱ lb.. ..... 6@7
26°, ₱ lb..... 10@11

Ammonia—Sul., ₱ 100 lbs..... 3.12½
Carb., per lb..... 7½@8½
Muriate per lb..... 6½@8

Arsenic—White, powdered, ₱ lb...3@3½
Red, ₱ lb..... 7@8
White, at Plymouth, ₱ ton. ..£12 2 6d.

Asbestos—Am., p. ton.....$50@$300
Italian, p. ton, c. i. f. L'pool..£18@£60

Asphaltum—P. ton 13.00
Prime Cuban, ₱ lb ..... 4½@5½c.
Hard Cuban, ₱ ton..... $28.00
Trinidad, refined, ₱ ton..... $30.00

Barytes—Sulph., Am. prime white16@20
Sulph., foreign, floated, p. ton.....20@21
Sulph., off color, p. ton 13.00
Carb., lump, f.o.b. L'pool, ton..... £6
No. 1, casks, Runcorn " "£4 10 0
No 2, bags, Runcorn " " 3 15 0

Bleach—Over 35 p.c., ₱ lb.. ... .. 1·60

Borax—₱ lb 9¼
Refined at Liverpool, ₱ ton..... £29

Brimstone—*See Sulphur.*

Bromine—₱ lb..... .....37@38

Chalk—₱ ton.. ... . 3.25@3.50
Precipitated, ₱ lb. ..... 4¾@5

China Clay—English, ₱ ton13.50@18.50
Southern, ₱ ton..... ..... 13.50

Chrome Yellow—₱ lb .... 10@25

Cobalt—Oxide, ₱ lb..... ..2·60@2·90

Copper—Sulph. English Wks.,ton.....£24
Precip., Eng. Wks, unit....fluctuating

Copperas—Common, ₱ 100 lbs.52@57½
Best, ₱ 100 lbs..... .....75@1.00
Liverpool, ₱ ton, in casks.....£1 15s.

Cream of Tartar—Am. 99%.... 23
Powdered, 99 p. c..... ..... 24½

Emery—Grain, ₱ lb ... . 4½@5
Flour, ₱ lb ..... 2¾@3½

Feldspar—Ground, ₱ ton.. ....15.00

Fuller's Earth—Lump, ₱ bbl. .90@95
Powdered, ₱ lb.. ....1¾@2

Gypsum—Calcined, ₱ bbl. 1.25

Iodine—Resublimed..... 3.50

Kainit—₱ ton..... .... 9.75@11.00

Kaolin—*See China Clay.*

Lead—Red, ₱ lb. ....6¼@7
White, American, in oil, ₱ lb... 6¾@7¼
White, English, ₱ lb ....8½@8¾
Acetate, or sugar of.....12@13

Lime Acetate—Amer. Brown. .95@1.00
" Gray1.75@1.87½

Litharge—Powdered, ₱ lb. .... .6½@6¾
English flake, ₱ lb... .....9@9½

Magnesite—Greek, ₱ ton.. ....20.00

Manganese—Crude, per unit....23@.28
Oxide, ground, per lb..... 2½@6½

Mercuric-Chloride — (*Corrosive Sublimate*) ₱ lb. ..... 67@69

Mineral Wool—₱ lb..... 2

Mica—In sheets according to size, 1st quality, ₱ lb.....25@$6 00

Phosphate Rock—S. Carolina, per ton f. o. b. Charleston. 5.50@6.00
Ground, ex vessel New York. 11.00
Canadian Apatite, lump, f. o. b. at Montreal, ₱ ton..... 16.00

Phosphorus—₱ lb..... .... 7C@75

Plumbago—Ceylon, ₱ lb. .... 4@5
American, ₱ lb..... 5@7

Potassium—Cyanide, ₱ lb.... .39@40
Bromide, ₱ lb..... 33
Chlorate, ₱ lb. ....13¾@15½
Carb. ₱ lb. ....4.70@5.50
Caustic, ₱ lb..... ..7½@8
Iodide..... .2.70@2.75
Muriate, ₱ 100 lbs..... 1.80
Nitrate, refined, ₱ lb.. .... 6@8
Bichromate, ₱ lb .... 11½@12
Sulphate, ₱ 100 lbs..... ....2.30@2 35
Yellow Prussiate, ₱ lb.... .... 17½@18
Red Prussiate, ₱ lb.. ..... 42@45

Pumice Stone—Select lumps, lb. 3¼
Original cks., ₱ lb.... .... 1¾
Powdered, pure, ₱ lb... .... 2¼@2½

Pyrites—Non-cupreous, p. unit, s. 10d.

Quartz—Ground, ₱ ton. 16.00

Rotten Stone—Powdered, ₱ lb..3¼@3¼
Lump, ₱ lb.... ..... 6@10
Eng., powdered, ₱ ton. £4
Lump, ₱ ton..... £5

Salt—Liverpool, ground ₱ sack.. 75@80
Turk's Island, ₱ bush ..... .25@27

Salt Cake—₱ lb..... .....50@57

Saltpeter—Crude, ₱ lb. ..... 5¼@5½
Refined, ₱ lb. ..... 6@8

Soda Ash—Carb.,48 % 100 lb...1.22½@1.30
Caustic, 48 % 1.25
Soda Caustic, 60%..... 2 40
" " 70%..... 2.15
" " 74–6%..... 2.15
Sal, English, ₱ 100 lbs.... .85
Sal, American, ₱ 100 lbs .... .80
Nitrate, ₱ 100 lbs..... 1.95

Strontium—Nitrate ₱ lb. ..... 9@9½

Sulphur—Roll, ₱ lb..... .... 1¾
Flour, ₱ lb 2
Crude Brimstone, 2s., ₱ ton.... 19.50
Crude Brimstone, 3ds. ₱ ton. 19.00

Talc—Ground French, ₱ lb .. ...1¼@1½
Domestic, ₱ lb ..... 1@1¼
c. i. f. Liverpool, ₱ ton..... £4 5

Vermillion—American, ₱ lb. .. 61
English, ₱ lb.. .. ..82@85

Vitriol—(Blue), Ordinary, ₱ lb..5¾@6¾
Extra, ₱ lb. 7

Zinc Oxide—Am., Dry, ₱ lb. 4½
Antwerp, Red Seal, ₱ lb..... .....6@6½
Paris, Red Seal, ₱ lb. ....6½@7
* Spot

THE RARER METALS.

Aluminum—(Metallic), ₱ lb. $4.00
" Sheet, per lb..6.00@8.00

Arsenic—Metallic, per lb..... 20

Barium—(Metallic), per lb..... .975.00

Bismuth—(Metallic), per lb..... 2.40

Cadmium—(Metallic), per lb..... 1.25

Calcium—(Metallic), per oz..... 150.00

Cerium—(Metallic), per oz..... 160.00

Chromium—(Metallic), per lb...200 00

Cobalt—(Metallic), per lb..... 6.00

Didymium—(Metallic), per oz..160.00

Erbium—(Metallic), per oz... ..140.00

Gallium—(Metallic), per oz ..3250.00

Glucinum—(Metallic) per oz ...250.00

Indium—(Metallic), per oz..... 158.00

Iridium—(Metallic), per lb..... 650.00

Lanthanum—(Metallic), per oz.175.00

Lithium—(Metallic), per oz..... 160.00

Magnesium—Per lb.... .... .. 4.50

Manganese—Metallic, per lb... 1.10
Chem. pure, per oz. 10.00

Molybdenum—(Metallic), per oz. 6.00

Niobium—(Metallic), per oz.....128.00

Osmium—(Metallic), per lb 640.00

Palladium—(Metallic), per lb...400.00

Platinum—(Metallic), per lb. ..140.00

Potassium—Metallic, per lb.. 28.00

Rhodium—(Metallic), per lb....512.00

Ruthenium—(Metallic), per oz.112.00

Rubidium—(Metallic), per oz...200.00

Selenium—(Metallic), per oz.. .. 3.00

Sodium—(Metallic) per lb. .. 2.75

Strontium—(Metallic), per oz...128.00

Tantallum—(Metallic) per oz...144.00

Telurium—(Metallic) per oz.... 9 00

Thallium—(Metallic) per oz..... 3.00

Titanium—(Metallic) per oz....32.00

Thorium—(Metallic) per oz.....272.00

Tungsten—(Metallic) per oz..... 4.00

Vanadium—(Metallic), per oz..320.00

Yttrium—(Metallic), per oz 144.00

Zirconium—(Metallic), per oz..240.00

METALS.

Aluminum—
94-96% pure, ₱ lb $5
Over 96% pure, ₱ lb.... 6

Copper—
Lake Ingot, Spot, ₱ lb.... .... 12c.
Electrolytic, ₱ lb .... 11½c.
Casting Brands, ₱ lb. ....
Chili Bars, London, ₱ ton £41
Sheet Copper (according to size), ₱ lb..... ..... 25@30c.
G. M. B..... £41

Nickel.—
Metallic, per lb..... 60c.

Lead—
Domestic, Common, Spot.... 4·10c.
Foreign..... ..... 4·90c.
Sheet, ₱ lb.... .... 6c.
Pipe, ₱ lb .... 6c.
Tin lined Pipe, ₱ lb..... 15c.
Shot, ₱ 25-lb. bag ..... 1·16c.
Spanish Lead, London.. .. . £12 10s.

Tin—
Tin Plates..... .. .. 13s. 9d.
Tin Spot in London . ... .. £49 10s.
Pig tin, spot in N. Y., ₱ lb.. 20·25c.

Zinc—
Domestic spelter, ₱ lb.... .. 5·00c.
Foreign spelter, ₱ lb... ... 5·80c.
Silesian, ton..... £18
Sheet, American, ₱ lb .... 6¼c.

Antimony—Hallet's, per lb.... 14½c.
Cookson's, per lb..... .. 14¾c.
Star Antimony..... .... £63

Quicksilver—Per lb..... .. 57@58c.
London, ₱ flask..... £8 5s @ £8 10s.

IRON AND STEEL.
New York Prices.

American Pig-Iron.—At tidewater.
No. 1 X..... .....$16.50@$18 00
No. 2 X..... ..... 15.50@ 16.00
Forge..... ..... 14.50@ 15.50

Scotch Pig—Coltness... $21.50@$21.75
Clyde..... .....
Dalmellington..... 19.50@.....
Summerlee..... 21.25@ 21 50
Shotts..... @ 21.00
Langloan ..... @ 21.00

By Cable to-day to the Metal Exchange :
Scotch Warrants..... .....43s. 8d.
Coltness, at Glasgow..... .....54s. 3d.
Langloan, at Glasgow..... .....53s. 3d.
Summerlee, at Glasgow..... .....53s. 6d.
Gartsherrie, at Glasgow..... .....52s.
Glengarnock, at Ardrossan..... .....51s. 6d.
Dalmellington, at Ardrossan..... .....45s. 3d.
Eglinton, at Ardrossan ....43s. 9d.

Bessemer Pig—
Foreign, nominally..... 20.50@ 21.00
Domestic " ..... 16 50@ 17.50

Spiegeleisen—
German, 20 per cent..... 28.00@ 28.50
English, 20 " " ..... 28.00@ 28.50
" 30 " " ..... 33.00@ 34.00
Ferro Manganese, 80%..... @ 60.00

Steel Billets, ... 30.00@ 33.00
Steel Nail Slabs, " 28.00@ 28 50
Steel Wire Rods, " @ 43.00

Steel Rails—
Heavy sections, at mill.... 27.50@ 28.00
Light " " 30.00@ 32.00

Structural Iron and Steel—
Bridge Plate, at mill.. .....2·00@2·1c.
Angles, at mill ..... 1·90@2·00c.
Tees, at mill..... .....2·40@2·50c.
Steel Angles, at mill.... ....2·15@2·25c.
Beams and Channels, on wharf, 2·3c. base.

Steel Plates—
Tank and Ship, on wharf.....2·15@2·25
Shell, on wharf..... ....2 4 @2·05
Flange, " ..... 2 6 @2 8
Fire-Box, on wharf..... .....3·25@4

Iron Plates—
Common tank, on wharf....2·05@2·25c.
Refined, on wharf..... .....2·3@2·4c.
Shell, " ....2·4@2·5c.
Flange, " ....3·5@3·7c.
Extra flange..... .....3¾@4

Bar Iron—
Refined..... ... . 1·7@2·0c.
Common ....1·60@1·7c.

Merchant Steel—
American tool .... 7½@10c.
Special grades..... ..... 13 @20c.
Crucible machinery ..... 5 @6c.
" spring..... .... .. 3¾@4¼c
Bessemer machiner, ... 2·25@ ·75c.
" spring. .... 2·25@2·70c.

Cast-Iron Pipe—At works:
According to size.... $25 00@$31.00

Wrought-Iron Pipe—nominal—
Butt-Welded, Plain and Tarred, 55% disc; Galv., 45% disc.
Lap-Welded, Plain and Tarred, 65% disc.; Galv., 55% disc.

Boiler Tubes—Per cent disc..... 60%

Rail Fastenings—
Spikes..... ... 1·95@2c.
Angle Fish-bars..... .1·75@1 85c
Bolts and Sq Nuts ..... 2·70@2·75
" Hex " ..... 2·80@3c.

Wrought Scrap—
No. 1 Yard *to vessel*..... 20.00

Cast Scrap..... ... .. 14.00

Old Car Wheels..... ... 17 00@18.00

Old Rails—Tees 22.00
—Doubles 23 00

Nails—In car-load lots. .. $1.80@ $2.00
—From store . 1.85@ 2.00
Nails .... $1.90 usual discount
Steel Nails..... ..... $1.90
Wire Nails..... ..... 2.55
Two per cent off for cash. * At works

Louisville Prices.

Hot Blast Irons—
So. Coke, No. 1..... ....$14.25@$14.75
" " No. 2..... 13.75@ 14 25
" " No. 3..... 12.75@ 13.25
Mahoning Valley (Lake Ore Mixture) ... . 17.50@ 18.50
So. Charcoal, No. 1..... 16.50@ 17.00
" " No. 2..... 16.00@ 16.50
Missouri Charcoal No. 1.... 17.50@ 18.00
" " No. 2.... 17.00@ 17.50

Forge Irons—
Neutral Coke.... .... $12.75@$13.25
Cold Short ..... 12.75@ 13.00
Mottled..... 11.75@ 12.00

Car Wheel and Malleable Irons—
Southern (standard brands).$21.50@$22.00
(other brands)..... " 17 50@ 18.00
Lake Superior..... 22.00@ 22 50

Pittsburg Prices.

Coke or Bituminous Pig—
Foundry No. 1 ....$16.25@16.50
Foundry No. 2..... ..... 15.25@15.50
Gray Forge No. 3..... 14.00@14.25
" " No. 4.... .. .. 13 75@13.85
White .... 13.25@13.50
Mottled..... 13.50@.....
Silvery..... .... 16.00@18.50
Bessemer..... ..... 15.75@16.00
Low Phos..... 20.50@.....

Charcoal Pig—
Foundry No. 1. .... 23.50@24.50
Foundry No. 2..... . . 22.00@23.50
Cold-Blast..... ..... 25.00@28.00
Warm-Blast..... .... 24 00@25.00
10 + 12% Spiegel..... 27.50@28.00
20% Spiegel 31.00
Muck-Bar..... .. .. 26.25@26.50
Steel Blooms..... .....@28.00
Steel Slabs .... 27.75@28 00
Steel Crop Ends..... 18.00
Steel Bloom Ends..... 18.00
Ferro Manganese, 80% . .... 61.00@61.25
Steel Billets..... 27.75@28.00
Old Iron Rails..... .. 22.00@22.25
Old Steel Rails..... .... 17.50@18.00
No. 1 W. Scrap..... .... 18.50@.....
No. 2 W. Scrap .... 17 50@.....
Steel Rails..... .... 27.50@28.00
" light sections... ..... 27.50@31.00
Bar Iron., nominal..... 1.65@ 1.70
Iron Nails..... 1.85@ 1.90
Steel Nails..... 1.85@ 1.90
Wire Nails..... .... 2.15@ 2.20

Philadelphia Prices.

Foundry No. 1..... $17.00@18.00
Foundry No. 2. ..... 16.00@16.50
Gray Forge..... 14.50@15.25
Bessemer Pig..... 19.00@ ....
Foreign Bessemer..... 20.00@.. ..
Spiegeleisen..... .....@28.00
Scrap, Selected..... 22.00@.....
No. 1 ..... 21.00@21.50
Cargo Scrap..... .. .. 20.00@21.00
Muck-Bars.. . ...@28.00
Merchant Iron... .... 1.60@ 1.90
Plate Iron..... 1.90@ 2.00
Tank Iron .... 2.00@ 2.10
Skelp Iron..... ..... 1.70@ 1.95
Angles... .... 1.95@.....
Beams and Channels..... .. 2.80@.....
Nails .... 1.70@ 1.90
Steel Rails..... ..... 27.50@28.00
Old Rails ..... 22.00@23.00

BUILDING MATERIAL.

Bricks—Pale, ₱ 1,000 ..... 3 25@3.75
Jerseys, ₱ 1,000..... ..... 4.50@5.00
Up Rivers, ₱ 1000..... ..... 5 25@5.75
Haverstraw seconds, ₱ 1000... 5.75@6.25
Haverstraw firsts ₱ 1,000.... 6.25@6.50
Fronts, nominal, ₱ 1000.
Croton..... .. 14.00@16.00
Wilmington..... 20.00@21.00
Philadelphia..... .. ... @28.00
Trenton ..... @28.00
Baltimore..... .....

Building Stone—Amherst freestone, ₱ cu. ft.. ..... 95@1.00
Brownstone, ₱ cu. ft..... .. 1.00@1.35
Granite, rough, ₱ cu.ft.... .. 45@1.25
Granite, Scotch ₱ cu. ft.. .. 1.00@1.15

Cement—Rosendale, ₱ bbl ..90@1.10
Portland, American, ₱ bbl. . 2 15@2.45
Portland, foreign, ₱ bbl.. .. 2.40
Portland, " special brands.2.45@3.75
Roman, ₱ bbl. ..... 2.65@2.85
Keene's coarse, ₱ bbl..... .. 4.50@5.50
Keene's fine, ₱ bbl.... ..... 7.00@8.25

Slate—Purple and green roofing, ₱ 100 ft.... ....
Red roofing, ₱ 100 sq. ft... .10.00@15.00
Black, roofing, ₱ 100 sq. ft... 4.50@5.25

Lime—Rockland, common ₱ bbl.... 1.00
Rockland, finishing, ₱ bbl.... ..... 1.20
St. John, com. and finish, ₱ bb'.... .90
Glens Falls, com. and fin., ₱ bbl .80@1.10

Labor—Ordinary, ₱ day..... 1.50@2.00
Masons, ₱ day 4.00
Plasterers, ₱ day..... .... 4.00
Carpenters, ₱ day..... ..... 3.50
Plumbers, ₱ day..... ..... 3.50
Painters, ₱ day ..... 2.50@3.50
Stonesetters, ₱ day..... .3.50@4.00
Tilelayers, ₱ day..... 3.50@4.50
Bricklayers, ₱ day..... 4 00

STOCK MARKET QUOTATIONS
Birmingham, Ala.

COMPANY.	Bid.	Asked.
Ala. R. Mill Co.	....	$60
Ala. Con. C. & C. Co.....	...	$30
*Alice Furnace.	$102	....
Anna Howe G. Mg. Co.... ..	$1¼	....
Bess. Land Co.	$22⅜@$22¼	$22⅞@$23¼
Bir. Fur. & Mg.	...	$15½
Bir. Mg. & M g.	...	$144
Broken Arrow.	$3	$3¾
De Bardeleben C. & I. Co....	$50	$55
Decat. L. Imp.	$9@$9½	$10@$10½
DecaturMin.L.	....	$25
Enterprise Mfg.	....	$50
*Eureka	$102	$108
Hen. S. & M.Co.	$65@$75	$80@$90
Jagger Towley C. & C.....	....	$11@$11½
Mag-Ellen....	$96	....
*Mary Pratt...	$100	....
Sloss I. & S....	$42	$44
†Sloss I. & S....	$94	$95½
††Sloss I. & S..	$64@$64½	$66@$67½
Tuscaloose C., I. & L. Co	$20	....
Tenn.C. & I. Co.	....	$37¾
*Williamson...	$102	....
Woodstock I. Co.	$57	$60

Prices bid and asked during week ending June 26th.
* Bonds. † First mortgage. †† Second mortgage.

Pittsburg, Pa.

COMPANY.	H.	L.	Closing
Allegheny Gas Co.	38.00	37.00	38.00
Bridgewater GasCo	*50.00	*48.00	*48.00
Chartiers Val. Gas.	*50.00	*50.00	*50.00
ConsolidatedGas Co	41 00	38.00	41.00
Forest Oil Co.. ...	96 00	95.00	95.00
La Noria Mining ..	1.75	1.63	1.63
Nat.Gas Co.of W.Va	70 00	67.00	67.00
New York & C. Gas Co	37.00	35.00	35.00
Ohio Valley Gas....	35.00	35.00	35.00
People's N. G. & P. Co.....	18.00	16.75	18.00
Philadelphia Co...	36.88	... ..	.....
Pine Run Gas.. .	*90.00	*90.00	*90.00
Pittsburg Gas.. ..	62 00	62.00	62.00
Silverton Mg. Co..	1.75	1.00	1.00
South Side Gas... ..	26.00	24.00	26.00
West & Cambria..	35.00	15.00	35.00
W'house A. B Co.	*117.75	*117.75	*117.75
W'house E. Light.	*50.00	*50.00	*50.00
Wheeling Gas ...	30.00	29.00	30.00

Sales during the week ending June 20:

Bridgewater G.Co.	30 shs.		$48@$50
Chartiers Valley..	12 "		50
Westinghouse	260 "		49½@50½

*Actual selling price.

Foreign Quotations.

London. June 15.

COMPANY.	Highest.	Lowest
Alturas Gold, Idaho...	4s.	3s.
Arizona Copper, Ariz..	18s. 6d.	18s.
Callao Bis, Venz.....	4s.	3s.
Carlisle, N. Mex	3s.	2s.
Colorado United, Colo..	3s. 6d.	2s. 6d.
Columbian, S. A.....	£2	£1¾
Comstock, Utah... ..	£1¼	£1⅛
Cons. Esmeralda, Nev..	3s.	2s. 6d.
Denver Gold, Colo....	2s.	1s. 6d.
Dickens Custer, Idaho.	4s.	3s.
Eberhardt, Nev	1s. 6d.	1s.
El Callao, Venezuela...	£3½	£3
Elmore, Idaho	4s.	3s. 6d.
Empire, Mont	£3-16	£1-16
Flagstaff, Utah.....	1s. 3d.	9d.
Garfield, Nev.....	6s.	4s.
Hambley Freehold N.C.	£1⅛	£7⁄8
Ilex, Cal..... ..	£⅜	£⅛
Jay Hawk, Mont	3s. 6d.	2s. 6d
Josephine, Cal	9s.	7s.
Kohinoor, Colo.....	4s.	3s.
Mason & Barry, Port....	£6¼	£6¼
Montana Lt., Mont	£1 13-16	£1 11-16
New California, Colo...	9s 3d.	8s. 9d.
New Consolidated.... ..	2s.	1s. 6d.
New Emma, S., Utah..	5s.	4s.
New Hoover Hill, N. C.	3s.	2s. 6d.
New La Plata, Colo...	2s. 6d.	1s 6d.
Old Lout, Colo.....	£1¼	£1
Pittsburg Cons.. Nev...	16s. 6d.	13s. 6d.
Quebrada, Venezuela...	£1	£¾
Richmond Con., Nev...	£2	£1½
Ruby&Dunderberg,Nev	1s. 3d.	9d.
Russell Gold, N. C.....	2s. 6d.	1s 6d.
Sierra Buttes, Cal.....	£11-16	£9-16
Stanly, N. C	4s.	2s
United Mexican, Mex...	£⅛	£⅜
U. S. Placer, Colo.....	3s.	2s.
Viola Lt., Idaho	2s. 6d.	1s. 6d.

Paris. June 13

Belmez, Spain.....	540.00	540.00
Boleo, Mex	365.00	365.00
Callao Bis, Venez	4.00	4.00
East Oregon, Ore.....	22.50	22.50
Forest Hill Divide, Cal.	350.00	350.00
Golden River, Cal	390.00	390.00
" " parts... .	60.00	60 00
Lexington, Mont. 13	2.50	132.50
" parts	5.25	5.25
Ouray, Colo....	55.00	50.00
Rio Tinto, Spain.....	280.50	280.50
Tharsis, Spain	89 37	89.37

DIVIDEND-PAYING MINES.

	Name and Location of Company.		Capital Stock.	Shares. No.	Shares. Par	Assessments. Total levied.	Assessments. Date and amount of last.			Dividends. Total paid.	Dividends. Date and amount of last.		
1	Adams, S. L.	Colo.	$1,500,000	150,000	$10	*	....	....	....	$555,000	Jan	1887	.15
2	Alice, S. C.	Mont	10,000,000	400,000	25	*	....	....	....	775,000	Dec.	1888	.06½
3	Alma Cons., G.	Idah.	300,000	30,000	10	*	....	....	....	45,000	Dec.	1888	.50
4	Alturas, G.	Idah.	1,500,000	300,000	5	....	....	....	....	262,500	Jan.	1888	37½
5	Amy & Silversmith, S.	Mon.	.....	341,419	....	....	....	....	....	247,530	Aug.	1887	12½
6	Atlantic, C.	Mich	1,000,000	40,000	25	$280,000	Apl.	1875	$1.00	520,000	Feb.	1889	2.00
7	Argenta, S.	Nev.	10,000,000	100,000	100	325,000	July	1887	.10	40,000	Feb.	1880	.20
8	Aspen Mg. & S., S. L.	Colo.	2,000,000	200,000	10	*	....	....	....	220,000	Jun.	1889	.20
9	Aurora, I.	Mich	2,000,000	100,000	20	*	....	....	....	155,000	Oct.	1887	1.87½
10	Bassick, G. S.	Colo.	10,000,000	100,000	100	*	....	....	....	400,000	Mar.	1884	1.00
11	Belle Isle, S.	Nev.	10,000,000	300,000	100	155,000	Apl.	1889	.10	300,00	Dec.	1887	.25
12	Belcher, G. S.	Nev.	10,400,000	104,000	100	2,822,000	Feb.	1889	.50	15,397,200	Jan.	1876	1.00
13	Bellevue Idaho, S. L.	Idah.	1,250,000	125,000	10	88,750	May	1889	.10	187,500	Jan	1887	10
14	Bodie Con., G. S.	Cal.	10,000,000	100 000	100	550,000	Mar.	1889	50	1,295,000	Apl.	1885	50
15	Boston & Mont, G.	Mon.	2,500,000	250,000	10	*	....	....	....	620,000	Jun.	1886	.15
16	Boston & Mont., C.S.	Mon.	2,500,000	100,000	25	*	....	....	....	500,000	Apl.	1889	1.00
17	Breece, S.	Colo	6,000,000	300,000	25	*	....	....	....	2,000	Feb.	1880	.01
18	Brooklyn Lead, L. S.	Utah	500,000	500,000	10	....	....	....	....	137,000	July	1887	.05
19	Bulwer, G.	Cal.	10,000,000	100,000	100	105 000	Apr.	1889	.25	175 000	Jan.	1884	.10
20	Bunker Hill & Sull.	Idah.	3,000,000	300,000	10	*	....	....	....	150,000	Oct.	1883	.06¾
21	Caledonia, G.	Dak.	10,000,000	100,000	100	505,000	May	1885	.15	104,000	Jun.	1889	.08
22	Calumet & Hecla, C.	Mich	2,500,000	100,000	25	1,200,000	....	....	....	32,350,000	July	1889	5.00
23	Carbonate Hill S. L.	Colo.	1,500,000	200,000	10	*	....	....	....	80,000	Apl.	1884	05
24	Carlisle, G.	N. M.	1,000,000	200,000	5	....	....	....	....	175,000	Dec.	1888	.12½
25	Castle Creek, G.	Idah.	100,000	100,000	1	....	....	....	....	51,000	Oct.	1883	.03
26	Catalpa, S. L.	Colo.	3,000,000	300,000	10	*	....	....	....	270,000	May	1884	.10
27	Central, C.	Mich	500.000	20.000	25	100,000	Sept	1861	.06	1,930,000	Feb.	1889	2.00
28	Chrysolite, S. L.	Colo.	10,000,000	200,000	50	*	....	....	....	1,650,000	Dec.	1884	.25
29	Colorado Central, S. L.	Colo.	2,750,000	275,000	10	*	....	....	....	392,250	Jun.	1889	.05
30	Confidence, S. L.	Nev.	.....	24,980	....	287,440	Apl.	1887	.50	199,680	Apl.	1889	1.00
31	Cons. Cal. & Va., G. S.	Nev.	21,600,000	216,000	100	108,000	Jan.	1885	.20	2,983,800	Jun.	1889	.50
32	Contention, S.	Ariz.	12,500,000	250,000	50	....	....	....	....	12,587,000	Dec.	1884	.25
33	**Cop. Queen Cons, C.	Ariz.	1,400 000	140,000	10	....	....	....	....	140,000	Oct	1888	.50
34	Crescent, S. L. G.	Utah	15,000,000	600,000	25	*	....	....	....	228,000	Oct.	1888	.03
35	Crown Point, G. S.	Nev.	10,000,000	100,000	100	2,825,000	Oct.	1888	.50	11,588 000	Jan.	1875	2.00
36	Daly, S. L.	Utah	3,000,000	150,000	20	*	....	....	....	1,087,50	Jun.	1889	.25
37	Deer Creek, S. G.	Idah.	1,000,000	200,000	5	*	....	....	....	23,000	Jun.	1889	.05
38	Deadwood-Terra, G.	Dak.	5,000,000	200,000	25	*	....	....	....	11,000,000	Nov.	1887	.10
39	Derbec B. Grav., G. S.	Cal.	10,000,000	100,000	100	90,000	Dec.	1881	.10	180,000	May	1887	.10
40	Dunkin, S. L.	Colo.	5,000,000	200 000	25	*	....	....	....	380,000	July	1889	.05
41	Dunstone, G. S. L.	Mont	1,000,000	200,000	5	*	....	....	....	6,000	Nov.	1888	.03
42	Eclipse.	Colo.	100,000	100,000	1	....	....	....	....	20,000	Nov.	1887	.10
43	Elknorn, G. S.	Mont	1,000,000	100,000	10	50,000	July	1883	.50	170,000	July	1887	.05
44	Empire Lt., G.	Mont	500,000	100,000	5	....	....	....	....	70,500	Oct.	1887	.37½
45	Eureka Con., G. S. L.	Nev.	5,000,000	50,000	100	650,000	Jun.	1889	.50	4,955,000	July	1889	.25
46	Evening Star, S. L.	Colo.	500,000	30,000	10	*	....	....	....	1,425,000	Apl.	1889	.25
47	Excelsior, G.	Cal.	10,000,000	100,000	100	560,000	Sept	1885	1.00	875,000	Oct.	1880	.25
48	Father de Smet, G.	Dak.	10,000,000	100 000	100	200,000	Nov	1878	1.00	1,125,000	Dec.	1885	.20
49	Franklin, C.	Mich	1,000,000	40,000	25	220,000	Jun.	1871	....	800,000	Dec.	1888	2.00
50	Freeland, G. S. C.	Colo.	5,000,000	200,000	25	*	....	....	....	190,000	July	1886	.10
51	Fresno Enterprise, G.	Cal.	5,000,000	100,000	50	....	Mch	1883	.10	110,000	July	1882	.10
52	Garfield Lt., G. S.	Nev.	500,000	125,000	5	....	....	....	....	85,000	Apl.	1888	12½
53	Golconda, G. S.	Idah.	1,000,000	100,000	10	....	....	....	....	120,000	May	1888	.60
54	Gould & Curry, G. S.	Nev.	10,800,000	108,000	100	4,402,200	May	1889	.30	828,800	Oct.	1870	10.00
55	Grand Central, S.	Ariz.	1,000,000	100,000	10	....	....	....	....	625,000	Dec	1882	.25
56	Grand Prize, S.	Nev.	10,000,000	100,000	100	625,000	Mar.	1889	30	49 000	Mar.	1884	.25
57	Granite, S. L.	Idah.	500,000	500,000	1	*	....	....	....	10,000	Jun.	1888	.02
58	Granite Mountain, G.	Mont	10,000,000	400,000	25	....	....	....	....	6,400,000	May	1889	.50
59	Green Mountain, G.	Cal.	1,250,000	125,000	10	*	....	....	....	212,000	Nov.	1881	.07½
60	Hale & Norcross, G. S.	Nev.	11,200,000	112,000	100	5,086,000	July	1887	.50	1,822,000	Aug.	1888	.50
61	Hecla Con., S. G. L. C.	Mont	1,500,000	30,000	50	....	....	....	....	1,332,500	May	1889	.50
62	Hel'a Mg & Red, G. S. L.	Mont	3,315,000	663,000	5	*	....	....	....	197,973	July	1886	.06
63	Holmes, S.	Nev.	10,000,000	100,000	100	300,000	Sept	1885	10	75,000	Apl	1886	.25
64	Holyoke, G.	Idah.	200,000	200,000	1	....	....	....	....	27,000	Feb.	1885	.10
65	Homestake, G.	Dak.	12,500,000	125,000	100	200,000	July	1878	1.00	4,403,750	Jun	1889	.10
66	Honorine, S. L.	Utah	500,000	250,000	2	37,500	Apl.	1889	.05	125,000	Sept	1887	.05
67	Hope, S.	Mont	1,000,000	100,000	10	*	....	....	....	238,252	Apl.	1888	.25
68	Horn-Silver, S. L.	Utah	10,000,000	400,000	25	*	....	....	....	4,000,000	Nov.	1884	.50
69	Hubert, G.	Colo.	500,000	50,000	10	*	....	....	....	239,500	Oct.	1888	.11
70	Idaho, G.	Cal.	310,000	3,100	100	....	....	....	....	5,166,150	Jun.	1889	5.00
71	Ideal, S. L.	Colo.	1,500,000	50,000	10	....	....	....	....	15,000	Oct.	1886	.05
72	Illinois, S.	N. M.	100,000	100,000	1	....	....	....	....	45,000	Apl	1889	.20
73	Independence, S.	Nev.	10,000,000	100,000	100	340,000	Oct.	1886	.20	225,000	Sept	1879	.25
74	Iron Hill, S.	Dak.	2,500,000	250,000	10	126,500	Jan.	1882	.03	156,250	Nov	1887	.07½
75	Iron-Silver, S. L.	Colo.	10,000,000	500,000	20	*	....	....	....	2,500,000	Apl.	1889	.20
76	Jackson, G. S.	Nev.	5,000,000	50.000	100	237,500	Nov	1880	.20	55,000	Jun	1889	.10
77	Jay Gould.	Mont	2,000,000	40,000	5	....	....	....	....	365,000	Apl.	1889	.04
78	Jocuistita, S.	Mex.	2,500,000	250,000	10	....	....	....	....	1,200,000	Feb.	1886	.50
79	Jumbo, G.	Colo.	2,000,000	200,000	10	....	....	....	....	35,000	Oct.	1886	.02½
80	Kentuck.	Nev.	3,000,000	30,000	100	351,000	Apl.	1889	.30	1,350,000	Dec.	1886	.10
81	La Plata, S. L.	Colo.	2,000,000	200,000	10	*	....	....	....	610,000	Sept	1882	.30
82	Leadville Cons., S. L.	Colo.	4,000,000	400,000	10	*	....	....	....	423,000	Apl.	1887	.05
83	Lexington, G. S.	Mont	4,000,000	40,000	100	*	....	....	....	565,000	Jan.	1885	2.00
84	Little Chief, S. L.	Colo.	10,000,000	200,000	50	*	....	....	....	800,000	July	1888	.10
85	Little Pittsburg, S. L.	Colo.	20,000,000	200,000	100	*	....	....	....	1,050,000	Mch.	1880	.50
86	Lookout, G.	Dak.	1,000,000	500,000	2	*	....	....	....	60,000	May	1888	.02
87	Marion Bullion, G.	N. C.	500,000	....	....	....	....	....	....	15,000	Jan.	1886	.....
88	Martin White, S.	Nev.	10,000,000	100,000	100	1,175,000	Jan.	1889	.25	140,000	Dec.	1886	.25
89	Mary Murphy, G. S.	Colo.	350,000	3,500	100	*	....	....	....	175,000	May	1888	5.00
90	Minnesota, C.	Mich	1,000,000	40,000	25	420,000	Apl.	1886	1 00	1,320,000	Mar.	1876	....
91	Mono, G.	Cal.	5,000,000	50,000	100	65,350	Mar.	1889	.25	12,500	Mar.	1886	.25
92	Montana, L. & S.	Mont	3,300,000	660,000	5	*	....	....	....	2,190,285	Jan.	1889	.06¼
93	Morning Star, S. L.	Colo.	1,000,000	200,000	10	....	....	....	....	775,000	Mar.	1888	25
94	Moulton, S. G.	Mont	2,000,000	400,000	5	*	....	....	....	386,000	Dec.	1887	.07½
95	Mount Pleasant, G.	Cal.	150,000	150,000	1	*	....	....	....	150,000	Feb.	1887	.30
96	Mt. Diablo, S.	Nev.	5,000,000	50,000	100	137,500	Jun.	1880	2.00	140,000	Jan.	1889	.40
97	Napa, Q.	Cal.	700,000	100,000	7	....	....	....	....	310,000	July	1889	.10
98	Navajo, G. S.	Nev.	10,000,000	100,000	100	485,000	Apl.	1888	.30	365,000	Apl.	1889	.10
99	New Guston, S.	Colo.	500,000	100,000	5	*	....	....	....	100,000	Dec.	1888	.50
100	N. Hoover Hill, G. S.	N. C	5,000,000	50,000	2½	*	....	....	....	30,000	Dec.	1885	.06½
101	Northern Belle, S.	Nev.	5,000,000	50,000	100	425,000	Jan.	1884	8.00	2,400,000	Apl.	1883	.50
102	North Belle Isle, S.	Nev.	10,000,000	100,000	100	350,000	Jan	1889	.50	230,000	May	1888	.50
103	North Star, G.	Cal.	1,000,000	100,000	10	....	....	....	....	150,000	Dec	1888	.50
104	Ontario, S. L.	Utah	15,000,000	150,000	100	....	....	....	....	10,175,000	Jun.	1889	.50
105	Ophir, G. S.	Nev.	10,000,000	100,000	100	4,159,440	May	1889	.50	1,595,800	July	1882	1.00
106	Original, G.	Mont	1,500,000	60,000	25	*	....	....	....	123,000	July	1888	.05
107	Osceola, S. C.	Mich	1,250,000	50,000	25	480,000	Apl.	1876	1.60	1,222,500	Mar.	1887	1.00
108	Oxford, G.	....	125,000	125,000	1	....	....	....	....	38,500	Oct.	1885	.02
109	Paradise Valley, G. S.	Nev.	10,000,000	100,000	100	57,000	Apl.	1888	.15	150,000	Apl	1887	.10
110	Parrot, C.	Mont	1,800,000	180,000	10	....	....	....	....	372,000	May	1889	.10
111	Peacock, S. G. C.	N. M.	2,000,000	200,000	10	*	....	....	....	60.000	Nov.	1886	....
112	Plumas Eureka, G.	Cal.	1,400,250	140,625	10	....	....	....	....	2,495,312	Apl.	1889	.50
113	Piutus, G. S. L.	Colo.	2,000,000	200,000	10	*	....	....	....	40,000	Feb.	1886	.10
114	Plymouth Con., G.	Cal.	5,000,000	100,000	50	*	....	....	....	2,280,000	Feb.	1888	.40
115	Quicksilver, pref., Q.	Cal.	4,300,000	43,000	100	....	....	....	....	1,599,593	May	1889	1.50
116	" com., Q.	Cal.	5,700,000	57,000	100	....	....	....	....	643,867	July	1882	.40
117	Quincy, C.	Mich	1,000,000	40,000	25	200,000	Dec.	1862	....	5,170,000	Feb.	1889	5.00
118	Richmond, S. L.	Nev.	1,350,000	54,000	25	*	....	....	....	4,312,587	Jun	1887	1.25
119	Ridge, C.	Mich.	500,000	20,000	25	219,939	Mar	1886	.50	99,785	Feb.	1880	.50
120	Robinson Con., S. L.	Colo.	10,000,000	200,000	50	*	....	....	....	585,000	Mar.	1886	.05
121	Robert E. Lee, S. L.	Colo.	10,000,000	100,000	20	....	....	....	....	100,000	Dec.	1882	.50
122	Savage, S.	Nev.	11,200,000	112,000	100	6,486,000	Jan.	1889	50	4,460,000	July	1889	3.00
123	Shosnone, G.	Idah.	150,000	150,000	1	....	....	....	....	7,500	Apl.	1883	.01
124	Sierra Buttes, G.	Cal.	2,225 000	122,500	10	....	....	....	....	1,568,145	Apl.	1888	.12½
125	Sierra Nevada, G. S.	Nev.	10,000,000	100,000	100	6,200,000	Jun.	1889	.25	102,000	Jan.	1871	1.00
126	Sierra Nevada, S. L.	Idaho	1,000,000	1	1	*	....	....	....	40,000	May	1889	.02
127	Silver Coast, G. S. L.	Colo.	5,000,000	500,000	10	....	....	....	....	275,000	Apl.	1889	.10
128	Silver King, G. S. L.	Utah	10,000,000	500,000	100	50,000	Jun.	1889	.50	1,950,000	July	1887	.25
129	Silver Mg. of L. V.	N. M.	500,000	500,000	1	*	....	....	....	50,000	June	1889	.05
130	Silverton, G. S. L.	Colo.	2,000,000	200,000	10	*	....	....	....	50,000	Nov.	1886	.02
131	Small Hopes Cons., S.	Colo.	5,000,000	250,000	20	*	....	....	....	3,137,500	Jun.	1889	.10
132	Smuggler, S. L.	Colo.	600.000	60,000	10	....	....	....	....	66,700	Aug.	1883	.25
133	Spring Valley, G.	Cal.	200,000	200,000	1	50,000	Oct.	1886	.25	50,000	Jan	1881	25
134	Standard, G. S.	Cal.	10 000,000	100,000	100	25,000	Oct.	1884	.25	3,595,000	Jun.	1888	.05
135	Stormont, S.	Utah	500,000	500,000	1	*	....	....	....	155,000	Nov	1881	.05
136	St. Joseph, L.	Mo.	1,500,000	150,000	10	*	....	....	....	944,000	Dec.	1887	.20
137	Surinam, G.	D. G.	3,000,000	600,000	5	*	....	....	....	105,000	Nov.	1887	.05
138	Swansea, G.	Colo.	600,000	60,000	10	*	....	....	....	9,000	Apl.	1888	.02½
139	Syndicate, G.	Cal.	10,000,000	100,000	100	38,729	July	1882	.15	48,308	Sept	1885	.10
140	Tamarack, C.	Mich.	1,000,000	40,000	25	520,000	Apl	1885	3.00	960,000	July	1889	3.00
141	Tip Top, S.	Ariz.	10,000,000	100,000	100	250,000	Sept	1883	.25	100,000	Nov	1881	.20
142	Tombstone, G. S. L.	Ariz.	12,500,000	500,000	25	*	....	....	....	1,250,000	Apl.	1882	.10
143	United Verde, C.	Ariz.	3,000,000	300,000	10	*	....	....	....	97,500	Feb.	1884	.20
144	Valencia, M.	N. H.	150,000	1,500	100	....	....	....	....	37,500	Apl	1886	2.50½
145	Viola Lt., S. L.	Idah.	750,000	150,000	5	*	....	....	....	272,500	Oct.	1888	.37½
146	Ward Cons., S. L.	Colo.	2,000,000	200,000	10	....	....	....	....	10,000	Apl.	1889	.05
147	Yankee Girl	Colo.	2,500,000	250,000	10	....	....	....	....	1,275,000	July	1887	.10
148	Yellow Jacket, G. S.	Nev.	12,000,000	120.000	100	5,500,000	Mar	1889	.50	2,184,000	Aug	1871	1.50
149	Webb City, L. Z.	Mo.	55,000	11,000	5	....	....	....	....	3,300	Jun.	1889	.10

G. Gold. S. Silver. L. Lead. C. Copper. * Non-assessable. † This company, as the Western, up to Dec. 10th, 1881, paid $1,400,000. ‡ Non-assessable for three years. § The Deadwood previously paid $275,000 in eleven dividends, and the Terra $75,000. Previous to the consolidation in Aug., 1884, the California had paid $11,120,000 in dividends, and the Con. Virginia, $24, 20,000. ** Previous to the consolidation of the Copper Queen with the Atlanta, Aug., 1885, the Copper Queen had paid $1,350,000 in dividends. ¶ 1,000,000.

NON-DIVIDEND-PAYING MINES

	Name and Location of Company.		Capital Stock.	Shares. No.	Shares. Par Value.	Assessments. Total levied.	Assessments. Date & am't of last.		
1	Agassiz Cons., S. L.	Colo.	$2,500,000	50,000	$50	*	....	....	....
2	Alloues, C.	Mich	2,000,000	80,000	25	$697,000	Mar.	1889	.50
3	Alpha Con., G. S.	Nev.	3,000,000	30,000	100	562.500	Nov.	1888	87½
4	Alta, S.	Nev.	10,080,000	100,800	100	2,248,800	Sept	1888	.50
5	Amador, G.	Cal.	400,000	200,000	2	*	....	....	....
6	American Flag, S.	Colo.	1,250,000	125,000	10	300,000	Jun	1877	.5
7	Anglo-Montana, Lt.	Mon.	600,000	120,000	5	....	....	....	....
8	Appalachian, Lt., G.	N. C.	1,500,000	300,000	5	....	....	....	....
9	Astoria, G.	Cal.	200,000	100,000	2	....	....	....	....
10	Barcelona, G.	Nev.	5,000,000	200,000	25	*	....	....	....
11	Beehive Con., G.	Cal.	10,000,000	100,000	100	173,500	Jan.	1883	.10
12	Belmont, S.	Nev.	5,000,000	50,000	100	735,000	Apl.	1886	.10
13	Best & Belcher, G. S.	Nev.	10,080,000	100,800	100	2,130,100	Jun.	1889	.25
14	Big Pittsburg, S. L.	Colo.	20,000,000	200,000	100	*	....	....	....
15	Bi-Metallic, S.	Mon.	5,000,000	200,000	25	*	....	....	....
16	Black Oak, G.	Cal.	3,000,000	300,000	10	*	....	....	....
17	Boston Con., G.	Cal.	10,000,000	100,000	100	170,000	Nov	1883	.25
18	Bremen, S.	N. M.	5,000,000	500,000	10	*	....	....	....
19	Brunswick, G.	Cal.	2,000 000	400,000	5	*	....	....	....
20	Bullion, G. S.	Nev.	10,000,000	100,000	100	4,007,000	Aug.	1888	.50
21	Calaveras, G.	Cal.	500,000	500,000	1	*	....	....	....
22	Carisa, G.	Wy.	500.000	100,000	5	*	....	....	....
23	Carupano, G. S. L. C.	Ven.	200,000	100,000	2	*	....	....	....
24	Cashier, G. S.	Colo.	500,000	250,000	2	*	....	....	....
25	Cen. Coal'n, G. S. L.	C. & A	2,000,000	200,000	10	*	....	....	....
26	Charles Dickens, G. S.	Idah.	1,250,000	250,000	5	*	....	....	....
27	Cherokee, G.	Cal.	1,500,000	150,000	10	*	....	....	....
28	Chollar, S.	Nev.	11,200,000	112,000	100	1,428,000	Oct.	1888	.50
29	Cleveland, T.	Dak.	1,000,000	500,000	2	*	....	....	....
30	Colchis.	N. M.	500,000	50,000	10	....	....	....	....
31	Commonwealth, S.	Nev.	10,000,000	100,000	100	170,000	Nov	1888	.50
32	Comstock, G. S.	Nev.	10,000,000	100,000	100	30 000	Mar.	1887	.15
33	Con. Imperial, G. S.	Nev.	5,000,000	50,000	100	1,800,000	Nov.	1888	.05
34	Con. Pacific, G.	Cal.	6,000 000	60,000	100	186,000	F b.	1869	.15
35	Cons. Silver, S.	Mo.	2,500,000	250,000	10	....	....	....	....
36	Courtlandt.	Colo.	500,000	50,000	10	....	....	....	....
37	Crescent, S. L.	Colo.	3,000,000	300,000	10	*	....	....	....
38	Crocker, S.	Ariz.	10,000,000	100,000	100	125,000	Jun.	1889	.10
39	Crowell, G.	N. C.	500,000	500,000	1	....	....	....	....
40	Dahlonega, G.	Ga.	250,000	250,000	1	....	....	....	....
41	Dandy, S.	Colo.	5,000,000	500,000	10	....	....	....	....
42	Dardanelles, G.	Cal.	1,000,000	100,000	10	....	....	....	....
43	Decatur, S.	Colo.	1,500,900	300,000	5	*	....	....	....
44	Denver City, S. L.	Colo.	5,000,000	500,000	10	*	....	....	....
45	Denver Gold, G.	Colo.	300,000	60,000	5	....	....	....	....
46	Durango, G.	Colo.	500,000	500,000	1	....	....	....	....
47	Eastern Dev. Co., Lt.	N. S.	1,500,000	150 000	10	990,000	Mar.	1889	1.00
48	El Cristo, G. S.	U.S.C	1,000,000	500,000	2	*	....	....	....
49	El Dorado, G.	Cal.	1,000,000	250,000	4	*	....	....	....
50	El Talento, G.	U.S.C	1,000,000	500,000	2	*	....	....	....
51	Empire, S.	Utah	10,000,000	100,000	100	....	....	....	....
52	Eureka Tunnel, S. L.	Nev.	10,000,000	100,000	100	....	....	....	....
53	Exchequer.	Nev	10,000,000	100,000	100	515,000	Apl.	1889	.25
54	Found Treasure, G. S.	Nev.	10,000,000	100,000	100	30,530	Apl	1889	12½
55	Gogebic L. Syn., I.	Wis.	5,600,000	200,000	25	*	....	....	....
56	Gold Cup, S.	Colo.	500,000	500,000	1	*	....	....	....
57	Golden Era, S.	Mon.	2 000,000	200,000	10	*	....	....	....
58	Gould Placer, G.	Colo.	5,000,000	200,000	25	229,314	Dec.	1888	.25
59	Gold Rock, G.	Cal.	1,000,000	500,000	2	*	....	....	....
60	Goodshaw, G.	Cal.	10,000,000	100,000	100	*	....	....	....
61	Grand Belt, C.	Tex.	12,000,000	120,000	100	....	....	....	....
62	Grand Duke.	Colo.	800.000	80,000	10	....	....	....	....
63	Great Remance, G.	U.S.C	1,000,000	500,000	2	*	....	....	....
64	Gregory-Bobtail, G.	Colo.	550,000	550,000	1	*	....	....	....
65	Gregory Con., G.	Mon.	3,000,000	300,000	10	....	....	....	....
66	Harlem M. & M. Co., G.	Cal.	1 000,000	200,000	5	....	....	....	....
67	Head Cent. & Tr. s. G.	Ariz.	10,000,000	100,000	100	....	....	....	....
68	Hector, G.	Cal.	1,500,000	300,000	5	45,000	Jan.	1889	.15
69	Highland, C.	Mich	500,000	25,000	20	*	....	....	....
70	Hollywood.	Cal.	200,000	100,000	2	*	....	....	....
71	Hortense, S.	Colo.	2,000,000	200,000	10	*	....	....	....
72	Huron, C.	Mich	1,000,000	40,000	25	280,000	May	1887	3.00
73	Iron Gold & Silver, S.	N. M.	1,000,000	200,000	10	*	....	....	....
74	Ironton, I.	Wis.	1,000,000	40,000	25	....	....	....	....
75	Iroquois, C.	Mich	1,250,000	50,000	25	....	....	....	....
76	J. D. Reymert.	Ariz.	10,000,000	100,000	100	*	....	....	....
77	Julia Cons., G. S.	Nev.	11,000,000	110,000	100	1,660,000	Jan.	1889	.10
78	Kearsarge, C.	Mich	1,250,000	50,000	25	190,000	Oct.	1887	1.00
79	La Gouldsa, S.	Colo.	1,000,000	100,000	10	*	....	....	....
80	Lee Basin, S. L.	Colo.	5,000,000	500,000	10	*	....	....	....
81	Mammoth Bar., G.	Cal.	10,000,000	100,000	100	50,000	Dec.	1881	....
82	May Belle, G.	Cal.	10,000,000	100,000	100	84,000	Mar.	1884	.15
83	Mayflower Gravel.	Cal.	1,000,000	100,000	10	485,000	Jan	1889	.50
84	Medora, G.	Dak.	250,000	250,000	1	*	....	....	....
85	Mexican, S.	Nev.	10,000,000	100,000	100	2 750,760	Mar.	1889	.25
86	Middle Bar, G.

NEW YORK MINING STOCKS QUOTATIONS.

DIVIDEND-PAYING MINES

NAME AND LOCATION OF COMPANY.	June 22.		June 24.		June 25.		June 26		June 27.		June 28.		SALES.
	H.	L.	H.	L.	H.	L.	H.	L.	H	L.	H.	L.	
Adams, Colo	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Argenta, Nev	.12	.....	....	....	..	....	..	....	....	....	....	....	500
Aspen Mg & S., Colo	....	.....	....	....	....	....	....	....	....	....	....	....	....
Atlantic, Mich	....	..	....	....	9 50	....	....	....	....	....	....	....	50
Belcher, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Belle Isle, Nev	.25	.20	....	....	....	.25	....	....	....	....	....	....	650
Bodie Cons., Cal	1.35	.....	1.35	....	....	....	....	....	....	....	....	....	400
Boston & Mont., Mont.	....	.....	....	....	39 13	....	....	....	....	....	....	....	15
Bulwer, Cal	.35	.....	....	....	....	....	....	....	....	....	....	....	400
Caledonia, Dak	....	.....	....	....	....	....	....	3.00	....	....	....	....	100
Calumet & Hecla	209½	.....	....	....	207½	....	....	....	....	....	....	....	15
Cataipa, Colo	.12½	.....	....	....	....	.17	.15	.20	....	....	....	....	520
Chollar, Nev	....	.....	....	....	....	....	....	....	....	1.70	....	....	100
Colorado Cent'l, Colo.	....	.....	1.90	....	1.90	....	1.90	1.85	....	....	....	....	800
Cons. Cal. & Va., Nev.	....	....	....	....	7 25	....	7.50	7.25	7.75	7.63	7.60	....	650
Crown Point, Nev	2.50	.....	....	....	....	....	....	....	....	....	....	....	100
Dunkin, Colo	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Eureka Cons., Nev	....	.....	....	....	....	....	....	1.90	....	1.90	....	....	200
Father de Smet, Dak	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Franklin, Mich	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Gould & Curry, Nev	2.15	.....	....	....	....	....	....	2 15	....	2.20	....	....	300
Grand Prize, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Hale & Norcross, Nev	....	....	3 50	.....	3.25	....	....	....	....	....	....	....	400
Holyoke, Idaho	....	....	....	....	....	....	....	....	....	....	....	....	.....
Homestake, Dak	....	....	....	....	....	....	....	....	....	....	....	....	.....
Horn-Silver, Ut	1 10	.98	1.00	.95	.95	....	1.00	....	....	.95	....	....	3,125
Iron Hill, Dak	....	.....	.54	....	....	....	....	.41	.40	....	....	....	300
Iron Silver, Colo	1.90	.....	....	....	....	....	....	....	....	....	....	....	700
Leadville C., Colo	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Little Chief, Colo	....	.....	....	....	....	....	.35	.30	....	....	....	....	5,500
Little Pittsburg, Colo	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Mono, Cal	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Moulton, Mont	....	.....	....	....	....	....	.40	....	....	....	....	....	200
Mount Diablo, Nev	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Navajo, Nev	....	.....	....	....	....	....	....	....	....	....	....	....	.....
North Belle Isle, Nev.	....	.....	....	....	....	....	....	....	....	.95	....	....	200
North Star, Cal	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Ontario, Ut	35.00	.....	....	....	35 00	34 25	....	....	....	....	35.25	....	236
Ophir, Nev	4.00	.....	....	....	....	....	....	....	....	....	....	....	100
Osceola, Mich	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Plutus, Colo	....	.....	90	....	.85	....	.85	....	.85	....	.84	....	1,700
Plymouth, Cal	....	.....	9 5	9 25	9 00	....	....	....	....	....	....	....	400
Quicksilver Pref., Cal	....	.....	....	....	38.50	....	....	....	....	....	....	....	100
" Com., Cal	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Quincy, Mich	49.75	.....	....	....	....	....	....	....	....	....	....	....	12
Robinson Cons. Colo.	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Savage, Nev	....	.....	....	....	....	....	....	2.00	....	2 10	....	....	400
Sierra Nevada, Nev	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Silver King, Ariz	....	....	.80	.72	.76	.75	90	.80	1.00	.80	1.05	.85	5,480
Silver Mg. of L. V	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Small Hopes, Colo	....	.....	....	....	....	....	1.25	..	1 25	....	....	....	225
Tamarack, Mich	104½	.....	....	....	103⅜	....	....	....	....	....	....	....	20
Yellow Jacket, Nev	....	.....	3 00	....	....	....	....	....	....	....	....	....	100

NON-DIVIDEND-PAYING MINES.

NAME AND LOCATION OF COMPANY.	June 22.		June 24.		Jun e 25.		June 26.		June 27.		June 28.		SALES.
	H.	L.	H.	L.	H.	L.	H	L.	H.	L.	H.	L.	
Alta	1.30	..	1.35	.....	1.70	....	1.25	....	....	....	....	....	550
Allouez, Mich	....	.....	....	.....	.85	....	....	....	....	....	....	....	200
Amador, Cal	....	....	....	....	....	....	....	....	....	....	....	....	.....
American Flag, Colo	....	....	....	....	....	....	....	....	....	....	....	....	.....
Astoria, Cal	.20	....	.20	....	.20	....	.10	....	.20	....	.20	....	1,600
Barcelona, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Best & Belcher, Nev.	2.90	....	3.10	....	3.15	....	....	....	3.25	....	3 25	....	625
Brunswick, Cal	....	....	.06	....	.05	....	....	....	....	....	....	....	600
Buffalo Iron Min'g.	....	....	....	....	....	....	....	....	....	....	....	....	.....
Bullion, Nev	.85	....	....	....	....	....	....	....	....	....	....	....	300
Cashier, Colo	....	....	....	....	.04	....	....	....	....	....	....	....	2,000
Castle Creek, Id	....	....	....	....	....	....	....	....	....	....	....	....	.....
Central Ariz., Ariz	....	....	....	....	....	....	....	....	....	....	....	....	.....
Colchis, N. M	....	....	....	....	....	....	....	....	....	....	....	....	.....
Commonw'th, Nev	....	....	....	....	4.45	....	....	....	....	....	4.15	....	200
Con. Imperial, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Con. Pacific	....	....	....	....	....	....	....	....	....	....	....	....	.....
Denver City, Colo	....	....	....	....	....	....	....	....	....	....	....	....	.....
Del Monte, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
El Cristo, U. S. Col	1.45	....	....	....	....	....	....	....	1.45	....	....	....	200
Excelsior, Cal	....	....	....	....	....	....	....	....	....	....	....	....	.....
Exchequer Nev	.90	....	....	....	....	....	....	....	....	....	....	....	100
Hector, Cal	....	....	....	....	....	....	....	....	....	....	....	....	.....
Julia, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Kingst'n & Femb'ke	....	....	.75	....	1.25	....	....	....	....	....	....	....	105
Kossuth, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Lacrosse, Colo	.09	....	.10	.09	.09	....	.09	....	.09	....	....	....	12,500
Lee Basin, Colo	....	....	....	....	....	....	....	....	....	....	....	....	.....
Mexican, Nev	....	....	....	....	....	....	....	....	....	....	3.30	....	100
Middle Bar, Cal	....	....	.24	....	.23	....	.23	....	.23	....	.24	....	2,200
Monitor, Colo	....	....	....	....	....	....	....	....	....	....	.03	.02	1,200
Mutual Sin. & M. Co	1.45	....	1 45	....	1.45	....	1.45	....	1.45	....	....	....	1,200
NevadaQueen, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
N. Com'nw'th, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Occidental, Nev	....	....	....	....	1 50	....	....	....	1.40	....	1 40	....	600
Oriental & Mil., Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Phœnix of Ariz	....	....	.35	.30	....	....	.30	....	....	....	....	....	4,000
Potosi, Nev	....	....	1 75	....	1.80	....	....	....	....	....	....	....	300
Rappahann'k, Va	.07	....	.07	....	.07	....	.07	....	.07	....	....	....	6,400
S. Sebastian, San S	.07	....	.10	....	.07	....	....	....	....	....	....	....	2,300
Scorpion, Ariz	.30	....	....	....	.17	....	....	....	....	....	.27	....	100
Shoshone, Idaho	.07	....	....	....	....	....	....	....	....	....	....	....	800
Silver Cliff, Colo	....	....	....	....	....	....	....	....	....	....	....	....	.....
Silver Hill, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Silver Queen	....	....	....	....	....	....	....	....	....	....	....	....	.....
Scate Line, 2&3, Nev.	....	....	....	....	....	....	....	....	....	....	....	....	.....
Sullivan Con	....	....	....	....	....	....	....	....	....	....	....	....	.....
Sutro Tunnel, Nev.	....	....	....	....	....	....	....	....	.08	.07	....	....	200
" Trust Cert.	....	....	....	....	....	....	....	....	....	....	.70	.60	1,100
Tornado, Nev	....	....	....	....	....	....	....	....	....	....	....	....	.....
Union Cons., Nev.	....	....	....	....	....	....	....	....	....	....	3 35	....	125
United Copper	1.10	....	1 20	1.15	1.10	....	1.10	....	1 10	....	....	....	1,100
Utah, Nev	.95	....	1.00	....	1.05	....	.95	..	....	....	....	....	525

*Ex. dividend. †Dealt in at the New York Stok Ex. Unlisted securities. ‡Assessment unpaid. Dividend shares sold, 23 998. Non-dividend shares sold, 38,331. Total New York, 62,328.

BOSTON MINING STOCK QUOTATIONS.

NAME OF COMPANY.	June 21.		June 22.		June 24.		June 25.		June 26.		June 27.		SALES.
Atlantic, Mich	.....	.....	....	....	9.50	.....	....	....	....	....	....	....	75
Bodie, Cal	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Bonanza Developm't	....	.....	....	....	....	....	....	....	....	....	.80	....	200
Bost. & Mont., Copper	38.50	38.25	38.88	38 25	39.00	38.75	39.25	39 00	39.00	.....	38.75	38.50	1,203
Breece, Colo	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Calumet & Hecla	209	207	209	208	209	208½	208	....	....	....	208	....	263
Catalpa, Colo	..	....	....	....	.13	.12½	..	....	....	....	....	....	1,200
Central, Mich	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Chrysolite, Colo	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Con. Cal. & Va., Nev.	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Dunkin, Colo	....	.....	1.05	....	....	....	....	....	....	....	....	....	100
Enterprise	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Franklin, Mich	..	....	....	....	....	....	9.50	9.25	....	....	....	....	150
Hale & Norcross, Nev.	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Honorine, Utah	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Little Chief, Colo	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Little Pittsburg, Colo.	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Martin White, Nev	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Mono, Cal	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Napa, Cal	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Ontario	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Osceola, Mich	....	.....	9 50	....	....	....	....	....	....	....	....	....	10
Pewabic, Mich	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Quincy, Mich	....	.....	....	....	....	....	....	51.00	....	....	....	....	2
Ridge, Mich	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Sierra Nev., Nev	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Silver King, Ariz	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Standard, Cal	....	.....	....	....	....	....	....	....	....	....	....	....	.....
Tamarack, Mich	104	103½	103½	.....	....	....	104	.....	105½	....	....	....	60

NAME OF COMPANY.	June 21.		June 22.		June 24.		June 25		June 26.		June 27.		SALES
Allouez, Mich	....	....	....	....	....	....	.90	....	....	....	....	....	100
Arnold, Mich	....	....	....	....	....	....	....	....	....	....	....	....	.....
Aztec, Mich	....	....	....	....	....	....	....	....	....	....	....	....	.....
Brunswick, Cal	....	....	....	....	....	....	....	....	....	....	....	....	.....
Butte & Boston	24.00	....	....	....	24.00	....	....	....	....	....	25.00	....	450
Canada	....	....	....	....	....	....	....	....	....	....	....	....	.....
Cashier, Colo	....	....	....	....	....	....	....	....	....	....	....	....	.....
Crescent, Colo	....	....	....	....	....	....	....	....	....	....	....	....	.....
Cusi, N. Mex	....	....	....	....	....	....	....	....	....	....	....	....	.....
Denver City, Colo	....	....	....	....	....	....	....	....	....	....	....	....	.....
El Cristo, W. S. C	....	....	....	....	....	....	....	....	....	....	....	....	.....
Everett	....	....	....	....	....	....	....	....	....	....	....	....	.....
Hanover, Mich	....	....	....	....	....	....	....	....	....	....	....	....	.....
Humboldt, Mich	....	....	....	....	....	....	....	....	....	....	....	....	.....
Hungarian	....	....	....	....	....	....	....	....	....	....	....	....	.....
Huron, Mich	....	....	....	....	....	....	1 25	....	....	....	....	....	100
Kearsarge, Mich	....	....	....	....	....	....	5.00	....	....	....	....	....	50
Mesnard, Mich	....	....	....	....	....	....	....	....	....	....	....	....	.....
National, Mich	....	....	....	....	1.00	....	....	....	....	....	....	....	25
Native, Mich	....	....	....	....	....	....	....	....	....	....	....	....	.....
Pontiac	....	....	....	....	....	....	....	....	....	....	....	....	.....
Rappahannock, Va	....	....	....	....	....	....	....	....	....	....	....	....	.....
Rockland	....	....	....	....	....	....	....	....	....	....	....	....	.....
Santa Fe, N. Mex	.70	....	.7	....	.75	....	....	....	....	....	.70	....	1,650
Security, Colo	....	....	....	....	....	....	....	....	....	....	....	....	.....
Shoshone, Idaho	....	....	....	....	....	....	....	....	....	....	....	....	.....
South Side, Mich	....	....	....	....	....	....	....	....	....	....	....	....	.....
St. Louis Cop	....	....	....	....	....	....	....	....	....	....	....	....	.....
Sullivan, Dak	....	....	....	....	....	....	....	....	....	....	....	....	.....

Boston: Dividend shares sold, 3,263. Non-dividend shares sold, 2,375. Total Boston, 5,638.

COAL STOCKS.

NAME OF COMPANY.	Par val. of sh'rs.	June 22.		June 24.		June 25.		June 26.		June 27.		June 28.		Sales.
		H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	
American Coal	.....	....	....	....	....	....	....	....	....	....	....	....	....	.....
Cambria Iron	.....	....	....	92	91	....	....	92	91½	92	.....	....	....	378
Cameron Coal & Iron Co	.....	....	....	....	....	....	....	....	....	32¼	.....	....	....	200
Ches. & O. RR	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Chic. & Ind. Coal RR	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Do. pref	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Col. & Hocking Coal	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Col., C. & I	100	30	29⅞	30½	30	31	30	31	....	29½	....	30	29½	4,670
Consol. Coal	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Del. & H. C	100	....	....	144¼	146½	148½	147½	148½	147½	148	147¾	....	....	4,100
D., L. & W. RR	50	148½	147⅛	147¾	147⅝	148⅝	147½	148⅝	148	148½	147¾	148	147⅜	76,610
Hocking Valley	100	....	....	146⅝	14½	16	143¾	15¾	15½	16¼	15¼	15¾	15¼	2,177
Hunt. & Broad Top	....	....	‡47½	....	....	....	....	....	....	....	....	....	....	.....
Do. pref	....	....	‡47½	....	....	....	....	....	....	....	....	....	....	100
Lehigh C. & N	50	53½	....	53¼	....	....	....	54	....	53⅞	....	....	....	118
Lehigh & W. B. Coal	....	33	32⅝	33	32¾	32½	....	34	32½	32	....	....	....	2,033
Lehigh Valley RR	50	53⅞	....	53⅞	53⅜	53⅝	53⅜	53¾	53½	53⅞	53⅝	....	....	2,133
Marshall Con. Coal	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Do. pref	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
Mahoning Coal	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Maryland Coal	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Morris & Essex	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
New Central Coal	50	....	....	....	....	....	....	....	....	....	....	....	....	.....
N. J. C. RR	100	113	112¼	112¼	111½	112¾	111½	112½	112	112⅛	111½	111	110	3,689
N. Y. & S. Coal	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
N. Y., Susq. & Western	100	....	....	8¾	8½	8⅞	8⅝	8⅝	8½	8½	8¼	....	....	800
Do. pref	100	....	....	34	....	34	33¾	34	33¾	33½	....	33⅜	33	1,650
N. Y. & Perry C. & I	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Norfolk & Western R.R.	50	....	....	52	51¾	15	....	15⅝	....	....	....	....	....	300
Do. pref	50	....	....	....	....	52½	52	51⅞	51¼	52⅜	52⅛	51½	....	1,960
Penn. Coal	50	....	....	....	....	....	....	....	....	....	....	....	....	.....
Penn. RR	50	51¾	51⅝	51¾	51½	51⅝	51½	51⅝	51⅜	51½	51⅜	....	....	5,440
Ph. & R. RR.**	....	48¼	48	48¾	47¾	48¼	47⅝	48¾	47⅞	48¾	48	48⅛	47⅞	162,476
Sunday Creek Coal	....	....	....	....	....	....	....	....	....	....	....	....	....	.....
Do. pref	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Tennessee C. & I. Co	....	....	....	38¾	....	39⅜	38⅞	39¾	39	39	36⅛	39¾	38⅛	4,970
Do. pref	100	....	....	....	....	....	....	....	....	....	....	....	....	.....
Westmoreland Coal	..	....	....	....	....	....	....	....	....	....	....	....	....	.....

‡Sold on last Friday.

**Of the sales of this stock, 42,351 were in Philadelphia, and 120,125 in New York. Total sales, 273,814.

San Francisco Mining Stock Quotations.

COMPANY	CLOSING QUOTATIONS.					
	June 21.	June 22.	June 24.	June 25.	June 26.	June 27.
Alpha	....	....	....	....	....	....
Alta	1.25	1.30	1.60	1.20	1.35	1.40
Belcher	....	....	....	....	....	....
Belle Isle	....	....	....	....	....	....
Best & Bel	2.80	2.95	3.20	3.00	2.80	2.90
Bodie	1.30	.....	1.35	1.40	1.40	1.35
Bulwer	....	....	....	.30	....	....
Chollar	1.50	1.60	1.75	1.65	1.55	1.60
C'm'weal'h	.....	.....	4.30	4.20	....	4.05
Con. C. & V	7.13	7.25	7.50	7.63	7.13	7.55
Con. Pac	....	....	....	....	....	....
Crown Pt	2.40	2 50	2.75	2.60	2.40	1.50
Eureka C	....	....	....	....	....	....
Gould & C	2.10	2.15	2.30	2.20	2.00	2.05
Grd. Prize	....	....	....	....	....	....
Hale & N	....	....	3.05	3.40	3.20	3.30
M. White	....	....	....	....	....	....
Mexican	2.85	3 00	3.20	3.15	2.95	3.00
Mono	1.05	.....	.....	1 05	.....	.....
Mt. Diablo	.....	.....	2.00	.....	.....	.....
Navajo	....	....	....	....	.40	....
Nev. Queen	1.00	1.05	1.10	....	....	....
N. Belle I	1.10	1.00	1.00	.90	.90	.85
Occidental	1.40	1.40	1.40	1.50	1.45	.....
Ophir	4.05	4.35	4.75	4.35	4.30	4.35
Potosi	1.50	1.65	1.65	1.55	1.50	1.50
Savage	2.00	2 00	2 15	2.05	1.95	1.90
Sierra Nev	2 00	2.10	2 25	2.20	1.95	1.95
Union Con	3.00	3.10	3.15	3.05	2.90	2.90
Utah	.85	.90	1.00	.90	.85	....
Yellow Jkt	....	3.05	3.15	2.95	2.75	2.85

facture of bleaching powder and the bleaching industry generally."

Carbonated soda ash, 48 per cent, is steady at about 1·25@1·35c., according to quantity. Several buyers, we understand, have been and are holding off, expecting to get this article at lower prices. As yet there has been little weakening in price. Caustic soda ash, 48 per cent, is quoted at 1·25@1·3c. according to quantity. Several small lots, remnants from cargoes, are offering from store.

Sal soda continues weak, at 85 cents per cwt.

Refined alkali is moving freely, at unchanged quotations.

Acids.—Business has been of moderate volume. Prices generally remain as last quoted. The market presents few features of interest. Oxalic is dull, and the only animation to be recorded is in small quantities. Although dealers are maintaining quotations of 9½@10½c. per pound, according to quality, it should be remembered that this is from three t four cents higher than the ruling prices at this time last year, and is perhaps a little higher than the actual condition of the market warrants. Muriatic, nitric, and sulphuric are unchanged.

Fertilizing Chemicals.—The market for crude fertilizing material has been dull and uninteresting, and there has been a general depreciation of values. Asking prices in some instances are the same as before, but as buyers are scarce actual values are probably somewhat lower than last week. While this is true of the list generally, in one or two articles a rather firmer tendency is apparent. After a careful canvass of the local trade, the following quotations are presented· Azotine, $2 35@$2.40; dried blood (city), low grade, $2.35 per unit; Western high grade, $2.37½@$2.40 per unit for ground material; tankage, high grade, $24@$25 per ton; low grade, $22@$23 per ton, as to quality. Fish scrap, $22@$23 per ton, f.o.b. factory. Sulphate of ammonia at $3.05@$3.12½ per cwt.

Refuse bone-black, guaranteed 70 per cent phosphate, $19@$20 per ton. Dissolved bone-black is 95c.@$1 per unit for available phosphoric acid, and acid phosphate 80c. per unit for available phosphoric acid.

Steamed bones, unground, $20; ground, $24.

Charleston rock, undried, $5 50 per ton; kiln dried, $6 50 per ton, both f.o.b. vessels at the mines. Charleston rock, ground, $11, ex-steamer at New York.

Muriate of Potash—Arrivals have been ligh ter than usual, and while the demand is still slow, there has been no important accumulations of supplies, or, at least, none sufficient to weaken prices.

We continue to quote $1.80 per cwt.

Double manure salts are in light demand. On a basis of 48 per cent potash, we quote $1.20 spot and $1.15 for future. High grade manure salt, or sulphate of potash, is quoted at $2 35 on the spot on a basis of 90 per cent potash. Futures are quoted at $2.50. It is stated that there are about 300 tons in store.

Kainit is moving more freely. The syndicates' sales agent informs us that since our last report two cargoes have been sold. Asking prices are unchanged. We continue to quote for shipment $9.75 per ton foreign invoice weight, and $10 per ton actual weight.

Brimstone has become more active, and it is estimated that about 4,000 tons have been sold during the week at prices ranging from $19 to $19.25 for best unmixed seconds, and $18.25@$18.50 for thirds to arrive. Spot is quoted at $18.50. Other and lower quotations have been heard, but it is understood that brokers would probably have some difficulty in filling orders at the low prices they are now quoting. Private advices from Italy state that freights are becoming scarce, and consequently the market here shows an upward tendency. Nitrate of soda is again weaker, being depressed by several fresh arrivals, and consequently large offerings. We get quotations of $1.90 per cwt.

Gypsum has been discovered in Florida by Colonel Eichelberger in his orange grove, near Panasoffkee Lake. Specimens have been analyzed by chemists in New York, it is reported, with gratifying results, showing 30 per cent of lime and 45 per cent of sulphuric acid. A foot-note to the chemists' report states that "this is an excellent gypsum for agricultural purposes." The deposit is found to cover an area of eight acres, and to range in depth from two to four and one-half feet. It is estimated to contain from one to two hundred thousand tons of rock, which is worth at least $5 per ton. A company with a capital stock of $100,000 has been organized for the purpose of getting out the gypsum and preparing it for market. A quarter of a million tons gypsum are consumed annually in the United States, and nearly two-thirds of the amount is imported from Nova Scotia, the remainder being derived mainly from beds in Ohio, Michigan and Kansas.

The following arrivals are reported:

CONSUMPTION.

Bleaching powder, 104 casks, SS. Critic, Liverpool.

Bleaching powder, 50 casks, SS. Critic, Liverpool.

Bleaching powder, 85 casks, SS. England, Liverpool.

Caustic soda, 50 drums, SS. England, Liverpool.

Caustic soda, 80 drums, SS. England, Liverpool.

Caustic soda, 259 drums, SS. England, Liverpool.

Caustic soda, 100 drums, SS. Aurania. Liverpool.

Caustic soda, 250 drums, SS. Germanic. Liverpool.

Caustic soda, 300 drums, SS. England, Liverpool.

Emery stone, 227 tons, SS. Columbus, Smyrna.

Soda ash, 494,522 lbs., SS. Aurania. Liverpool.

Soda ash, 223,963 lbs., SS. City of Rome, Liverpool.

Soda ash 276,157 lbs., SS. Germanic, Liverpool.

Sal soda, 8,960 lbs., SS. Aurania, Liverpool.

Pumice stone, 150 casks, SS. Highlander, Marseilles.

WAREHOUSED.

Caustic soda, 50 drums, SS. Critic, Newcastle.

Mr. Thomas Ward, of the English salt syndicate, sent here to value the properties of the North American Salt Works, sailed from this city to Hamburg on the 27th inst. on the steamer Augusta Victoria. He has visited a number of the plants now under option of his company, and it is said that his report will be of such a character as will result in the placing of a large quantity of the stock in England, especially among the shareholders of the English Salt Union.

Liverpool. June 15.

[Special report by J. P. Messrs. BRUNNER & Co.]

Chemicals.—There is very little moving in chemicals at present, business being almost entirely suspended, owing to the Whitsuntide holidays. Soda ash is attracting little attention from buyers, and quotations nominally unaltered. We quote: Caustic ash, 48 per cent, 1 9/16@1 5/32d.; high test, 1 1/32@1 1/16d.; carbonate ash, 48 per cent, 3/32 @1 1/16d.; high test, 1@1 1/16d. Soda crystals are dull at £2 7s. 6d.@£2 10s. Caustic soda is in light request, but holders are not pressing sales. We quote: 60 per cent, £5 10s. to £5 12s. 6d. and little offering; 70 per cent, £6 6s. 3d. to £6 7s. 6d., while with an order firm in hand second hand parcels might possibly be picked up at £6 5s.; 74 per cent, £6 15s. to £6 17s. 6d.; 76 per cent., £8 5s. to £8 10s. nominal. Bleaching powder is depressed and orders scarce; nearest spot values are £6 to £6 5s. Chlorate of potash is neglected, and 4¼d. to 4½d. nominal quotations. Bicarbonate of soda is selling freely at £4 12s. 6d. to £4 15s. per ton for 1 cwt. kegs, according to brand and quantity, with usual allowances for larger packages. Sulphate of ammonia is quiet but steady at £12 to £12 2s. 6d. for good gray 24 per cent f.o.b. Liverpool.

BUILDING MATERIAL MARKET.

NEW YORK, Friday Evening, June 28.

Bricks.—The market has been steady and, as a rule, strong since our last report. Three weeks ago, when values were unusually depressed, we pointed out that the only way the then existing condition of affairs could be remedied was by prompt, harmonious, and conservative action on the part of the Hudson River manufacturers.

Our advice was followed, shipments were curtailed, and since then there has been a gradual improvement in the tone of the market and in prices. During the week ending to day, the advance reported in our last issue has been sustained, and in some instances receivers have been able to secure 25 cents per M. more, or $6.50 for good quality Haverstraws. We quote $5.75 to $6 50 per M. for Haverstraws, according to quality; $5.50 to $6.00 for uprivers and from $4.50 to $5.50 for Jerseys, depending upon grade and make. Pales continue at $3.25@3.75, and are in good demand at these figures. The causes for the improvement this week were, first, somewhat of an increase in the demand, and secondly, a diminution of cargo offerings.

Haverstraw manufacturers claim that it costs $7 per M. to make brick and land it here in New York, making due allowances for losses on washed brick and all incidental expenses. Accurate information on this point would be interesting.

Lime is still rather scarce. The demand continues good and arrivals find a ready market. No change in quotations for Rockland, St. John or Glen Falls lime is reported.

ALBERT MEYER,

Analytical Chemist and Assayer.

Ores, Alloys, Smelters' Products, etc.

Blue Island, Ill.

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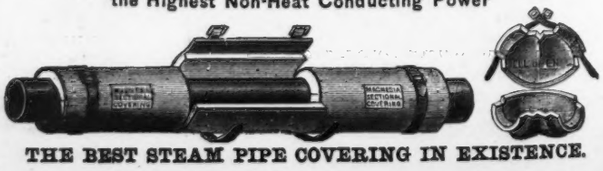


THE BEST STEAM PIPE COVERING IN EXISTENCE.

(CONTINUED FROM PAGE 438.)

TABLE 112.—BIRMINGHAM WIRE GAUGE (B. W. G.).

No. B. W. G.	·0000	·000	·00	·0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Diameter, inches	·454	·425	·38	·34	·30	·284	·259	·238	·220	·203	·180	·165	·148	·134	·120	·109	·095	·083	·072	·065
Difference in diam., inches		·029	·045	·040	·040	·016	·025	·021	·018	·017	·023	·015	·017	·014	·014	·011	·014	·012	·011	·007	·007

No. B. W. G.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Diameter, inches	·058	·049	·042	·035	·032	·028	·025	·022	·020	·018	·016	·014	·013	·012	·010	·009	·008	·007	·005	·004
Difference in diam., inches		·009	·007	·007	·003	·004	·003	·003	·002	·002	·002	·002	·001	·001	·002	·001	·001	·001	·002	·001

little of the wire is drawn through. It is then fastened to the drum or "block" A, which is now rotated by gearing, gradually drawing the wire completely through the draw-plate. In wet drawing the reel stands in a wooden tub which holds the lees liquor.

The tendency of modern practice is towards heavier draughts. Thus while some mills reduce from 6 (rod) to 12 gauge in six draughts, the more advanced use but three or at most four draughts. The reduction may be heavier in the draught immediately following an annealing than in later ones. After wire has been reduced to about 18 or 20 gauge, further reduction is usually at the rate of one gauge number per draught.

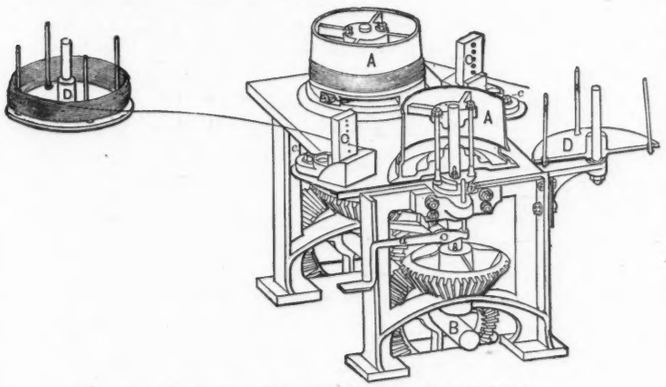


Figure 101.—Wire-drawing Machine. (After Beckert.)

A The power-driven drum or "block" which draws the wire through the draw-plate, and on which the drawn wire coils.
B The shaft which drives **A**.
C The die or draw-plate through which the wire is drawn.
D The reel on which the wire to be drawn is coiled.
The wire passes from **D** through **C** to **A**.

The resistance which the wire offers to drawing depends on its hardness, on the reduction, and on the taper of the hole. In the following table the resistance offered by hard steel wire (No. III.) is over thrice that offered by soft Swedish iron wire (No. I) under like conditions.

TABLE 113.—RESISTANCE OF WIRE TO DRAWING (MORGAN, LOC. CIT).

	I. Soft Swedish iron wire.		II. Half-hard Bessemer steel wire.		III. Hard crucible steel wire.	
Diameter before drawing	·224″	5 gauge	·226″	5 gauge	·224″	5 gauge
" after "	·191	6¼ gauge	·197	6¼ gauge	·192	6¼ gauge
Reduction of area, per cent.	27·3	.....	24·9	.....	26·6	
Length of taper of wire in die	0·28	.....	0·29	.....	0·34	
RESISTANCE, pounds	1,060	.....	3,054	.....	3,450	
Carbon, per cent.	.....	.....	0·45	.....	0·86	
Silicon	·031	.....	·068	.....	·209	
Manganese	·399	.....	1·04	.....	0·461	
Sulphur	·006	.....	·052	.....	·025	
Phosphorus	·034	.....	·144	.....	·114	

H. ALLEN (PROC. INST. CIV. ENG., XCIV., 1888).

	IV. Mild steel.	V. Mild steel.	VI. Mild steel.
Diameter before drawing	·265	·221	·205
" after "	·220	·183	·155
RESISTANCE, pounds	2,200	1,850	1,600
Carbon, per cent.		0·115	
Silicon		0·009	
Manganese		0·410	
Sulphur		0·068	
Phosphorus		0·072	

I. to III., Morgan, Trans. Am. Inst. Min. Eng., IX., p. 672.
IV. to VI., H. Allen, excerpt Proc. Inst. Civ. Eng., XCIV., 1888.
The resistance in pounds is given by Morgan as 1·060, 3·054 and 3·450, but the decimal point is apparently here given by typographical error for a comma.

In Vávra's experiments on drawing Bohemian iron wire, the speed of the drawn wire varied from 120 feet per minute for 0·24″ diameter (4 gauge) to 199 feet for 0·7″ diameter (15 gauge).[a] Bädeker gives the usual speed as from 148 to 180 feet per minute.[b]

The finer, *i. e.*, more flexible, the wire the smaller is the diameter of the block employed. The diameter and speed of block and the usual reduction per draught at a well-known American wire-mill are given in Table 114.

TABLE 114.—SOME DETAILS OF WIRE-DRAWING IN AN AMERICAN MILL.

Block. Designation.	Diameter, inches.	Revs per minute.	Circumferential velocity, feet per minute.	Reduction. Size. Initial. B. W. G.	Initial. Inches, A.	Final. B. W. G.	Final. Inches, B.	Ratio of diam. final ÷ diam. initial,
Rippers	26	45	306·3	5	·22	6½	·19	·86
				6½	·19	7¾	·18	·95
8 size	22	45	.....	7¾	·169	9	·148	·87
12 size	22	45	.....	9	·148	10½	·134	·90
	22	60	345·6	10½	·134	12	·12	·89
	22	.....	.....	12	·109	13	·095	·87
14 size	22	.....	.....	13	·095	14	·083	·87
	22	75	432	14	·083	15	·072	·87
	22	.....	.....	15	·072	16	·065	·90
	16	90	377	16	·065	17	·058	·89
16-inch blocks	16	90	377	17	·058	18	·049	·84
	16	.....	.....	18	·049	19	·042	·86
	16	.....	.....	19	·042	20	·035	·83
	8	56	117·3	20	·035	21	·032	·91
	8	56	117·3	21	·032	22	·028	·87
8-inch blocks	8	56	117·3	22	·028	23	·025	·89
	8	56	117·3	23	·025	24	·022	·88
	8	56	117·3	24	·022	25	·02	·91

Where great strength is sought the reduction may be twice or even two and a half times as great as this.

Draw-Plates, Figure 102, examples of whose composition are given in Table 115, are usually made of intensely hard steel, sometimes it is said of chrome or tungsten steel. For comparison examples of the composition of mint dies are given:

TABLE 115.—COMPOSITION OF WIRE AND MINT DIES.

No.	Authority.	Description.	Carbon.	Silicon.	Manganese.	Phosphorus.	Sulphur.	Tungsten.
1	Metcalf.	Wire dies too soft	1·37	.....	.....	.....	.....	0·78
2	"	" " "	1·70	0·20	0·387	0·02	0·091	
3	"	best European	2·89	0·14	0·26	0·02	0·031	
4	"	" American, as good as No. 3	2·37	0·20	0·18	0·03	0·091	
5	"	very good	1·97	0·013	0·396	0·014	0·009	
6	"	"	1·92	0·119	0·356	0·019	tr.	
8	Roberts.	Best mint dies	0·82	0·05	0·10	.....	tr.	
9	"	" "	1·07	0·06	0·12	tr.	tr.	Cu.
10	"	Mint dies, apt to crack in hardening	0·79	0·18	0·24	0·01	0·01	0·02
11	"	"	1·19	0·29	0·45	tr.	tr.	
12	.....	Best American mint-dies, Foster's steel	1·20	0·17	0·22	0·004	0·029	

1 to **4**, Trans. Am. Inst. Min. Engrs. IX., p. 549, 1881. Number 3 appears to approach the composition of Boulat, which, according to Chernoff, contains 3¾ of carbon, yet is malleable. Rev. Univ. 1877, I., p. 400. **5**, **6**. Unusually good dies: good malleable cast-steel. The diameter of a coil of wire 1,160 feet long of 1⅞ of carbon, drawn through such a die from .105″ to .092″, did not vary by 0·00025″. Trans. Am. Soc. Civil Engrs., XV., p. 293, 1887. **8** to **11**, W. C. Roberts, Chem. News, XLIII., p. 239, 1581; Jour. Iron and Steel Inst., 1881, II., p. 607. From number 8 200,000 florins were struck, while the normal output per die is 50,000. From 9 the average output is 54,000 pieces. **10** and **11** are apt to crack in hardening. Mint die steel is so soft as to take the impression from a bronze piece. I have a bronze coin struck from a die so prepared. Under a strong lens it is seen to be less sharp than common coins, but under casual observation it would probably pass unnoticed.

12, Mint die steel made by Alex. Foster & Co., Philadelphia. C. E. Barber (Engraver U. S. Mint at Philadelphia, private communications May 21st, July 31st, 1888), states that, after employing Jessop's steel, he introduced the use of Foster's steel in 1876. "It has proved superior to any other, giving us a far greater average per pair of dies than any steel ever used in this mint, and, so far as I am able to learn, our average is better than any of the mints in Europe." The composition here given was kindly determined by Messrs. Hunt and Clapp, of Pittsburg, for this work. The average output per silver-dollar die in 1887 was 372,307 pieces; 559,146 has been reached for an average in making bronze one cent pieces.

The wire-drawer himself makes the holes in his die, punching or "pricking" them: this is said to demand great skill, the least inaccuracy breaking the punch in the hole. As the die wears it is closed from time to time, say every few hours, by hammering the metal together around the small end of the hole.

[a] Jour. Iron and St. Inst., 1884, I., p. 227. Oest. Zeit. XXXII., p. 199.
[b] Stahl und Eisen VI., p. 182, 1886; Iron Age, April 1, 1886, p. 25.

Hard white cast-iron dies also are used for the coarser sizes of wire, say Number 9 B. W. G. and coarser. It might indeed be difficult to make holes in this material small enough for the very fine sizes of wire: the punching or pricking used in case of steel dies is hardly applicable to the white cast-iron. When the hole in a cast-iron die wears unduly large, it can be reamed out and used for the next larger size of wire.

The relative merit of cast-iron and steel dies for the coarser sizes is in dispute; each is used in important and intelligently conducted American mills.

When extreme accuracy is sought a sectional steel die may be used, the play between its sections being initially too small to cause a fin on the wire, yet such that, by gradually taking it up, the drawer can compensate for the wear which occurs in drawing a single long coil. Gems too may be used for accurate drawing. Their use is rare in this country, but much more common I am told in Britain.

The draw-plate is in some cases canted slightly to the rear, say by from 2° to 8°, to "kill" the wire, *i. e.* to prevent the tendency to spring out into an unmanageably large coil on removal from the drum: experiments in drawing wire for the Woodbridge gun tended to show that this was not strictly necessary.

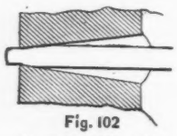


Fig. 102

Drawplate (Morgan).

§ 279. ANNEALING.—The coarser sizes of wire and any wire-rods which may have been rolled at so low a temperature as to render annealing desirable, are often annealed in muffles:[a] the finer sizes are annealed in pots (figure 103), which permit less oxidation. They are usually of cast-iron, sometimes of boiler-plate. The covers are often double, to exclude the air more completely. The annealing temperature may be about 700° to 800° C. (292° to 1472° F.), and sometimes as high as 982° C. (1800° F.). In certain cases, *e. g.* immediately before galvanizing, wire may be annealed by passing through pipes, or between iron plates, each externally heated. (Figure 105).

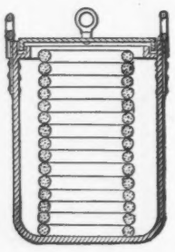


Fig. 103

Annealing Pot.

I have already pointed out that fine wire cannot well be annealed, its enormous proportion of surface leading to excessive oxidation in annealing and excessive corrosion and consumption of acid in pickling, its fineness making it hard to wash. In practice it is rare to anneal wire finer than 19 gauge, and in some mills none finer than 14 gauge is annealed (save of course the final annealing after the last draught in case of wire which is to be sold as annealed). Thus No. 33 wire must usually undergo 14 and sometimes 19 passes without annealing:[b] this is so trying that only the best, *i. e.* costliest, metal can be drawn to the finer sizes, and even then the loss by breakage is serious.

Even with coarser wire the loss of iron by corrosion, the consumption of acid for pickling, and the pollution of streams with the pickling liquor, are serious matters; the tendency of modern practice is towards less frequent annealing. In drawing from wire-rod to fine wire there were formerly as many as four annealings, to-day only two in the best mills. Wire-rods can now be rolled hot to 6 gauge in repeating mills such as Garrett's, and at least to 8 gauge in continuous (Bedson) mills: from the former size the wire can be drawn to 12 or even 13 gauge, from the latter to 14 gauge, without annealing.

The bad consequences of annealing just noticed are due to the oxidation which it entails: a non-oxidizing annealing is urgently needed not only that we may avoid them, but also for making wire which is to be at once bright and very tough: for many purposes a "bright annealed" wire is in demand. Hence the many devices for rendering annealing non-oxidizing, and for removing the oxide coating without pickling. Some of the former have at least succeeded in diminishing oxidation so far that a much less concentrated acid is needed for pickling, lessening the consumption of acid and loss of iron. Indeed, Bädeker[c] states that, when using new double-covered pots, many wire-drawers avoid pickling middle-sized wire (9 to 15 gauge?), the fine wire drawn from it being as bright as that from pickled wire. Of these devices we may note the following.

1. Mechanical devices for removing the scale.[d] In some of these the wire is bent back and forth *e. g.* as in Adt's apparatus, Figure 104, by passing between a series of rolls with parallel axes placed staggeringly, the wire being bent first vertically then horizontally. In others the wire is stretched up to its elastic limit, when much of the scale falls off. Employing a set of rolls for bending the wire Bädeker[e] uses only 6·5 pounds of 60° B. sulphuric acid per ton of wire.

2. Devices for diminishing the quantity of void in the annealing pots, *e. g.* by placing the coils of wire in annular spaces, by filling the voids with sand or infusorial earth, etc.

3. Filling the pots with non-oxidizing gases, carbonic oxide, producer gas, gas distilled from coal, horn, wood, etc., gas-yielding substances being sometimes enclosed in the pots, out of contact of the wire.

[a] Ovens heated from without, so that the charge within them is not exposed to the fuel nor to the products of its combustion.

[b] Though coarse wire is raised in some cases to above 230° C. (446° F., the melting point of tin) by the friction in the draw-plate, yet fine wire remains so cool that it may be grasped in the fingers as it issues from the draw-plate: its highest temperature in drawing may not be above 180° F. (82° C.), at which no important annealing probably occurs. It is most improbable that the wire is materially hotter even at the instant when it is in the draw-plate, for we see no path through which heat can escape rapidly enough to account for a rapid fall of temperature after the wire has left the plate. Nor do we notice a very rapid rise of temperature as we slide our fingers along the departing wire towards the draw-plate.

[c] Bädeker, loc. cit. He exhibited coils of No. 21 wire (0·032", 0·8mm.) which had never been pickled, even after leaving the rolling-mill, the rolling-mill scale probably having been removed mechanically, and serious oxidation having been avoided in the subsequent annealing.

[d] Wedding describes and illustrates many of these devices in Stahl und Eisen, VI., p. 14, 1886, No. 1.

[e] Idem, p. 182: Iron Age, April 1st, 1886, p. 25.

Nitrogen should be perfectly harmless and efficient:[a] hydrogen and hydrogen-bearing gases might be injurious.[b] Carbonic acid would oxidize the iron; and even carbonic

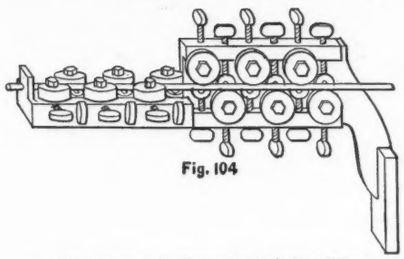


Fig. 104

Adt's Apparatus for Removing Scale from Wire.

oxide would oxidize it slightly,[c] but perhaps so slightly that its effects would be wholly removed in drawing: it might be generated in the pots by enclosing charcoal in them, but this would have to be kept out of contact of the wire lest carburization occur. It has been proposed to generate carbonic oxide in the pots by placing calcite and coke or charcoal within them. So too the hot pipes used for annealing wire may be filled with non-oxidizing gases: but the wire will still oxidize in cooling unless protected, *e. g.* by passing at once into water.

4. Similar to the last is the plan of placing iron filings within the pots to consume the oxygen present, leaving an atmosphere of nitrogen. It is said to have given good results.[d] I suggest the use of iron sponge as a much more energetic and probably cheaper absorbent.

5. *Wrought-iron* or *steel* instead of cast-iron pots,[e] preferably enclosed in cast-iron ones to avoid injury by the flames.

6. By annealing in a bath of lead, which melts at 335° C. (635° F.) Wedding[f] would avoid oxidation. Bädeker[g] assails the project vigorously, holding that the wire would not grow hot enough to be annealed if passed through a lead bath of reasonable size at the speed employed in drawing: this may be true of wire-rod, but I doubt if it is of wire of moderate size. Apart from this, the lead would probably adhere to the wire in spots: this would be disastrous except when the wire was to be galvanized. Further, as iron acquires an oxide tint at 220° C. and becomes dark blue at about 316° C., more or less oxidation would certainly occur in cooling, unless the wire were specially protected after leaving the lead.

In certain cases where extraordinary strength is needed steel wire is hardened by quenching before receiving the final passes, but this causes a great loss of ductility. Hence for extreme strength combined with a moderate amount of ductility wire is better hardened after it has received its last draught. Armstrong[h] states that the elastic limit of wire is raised by careful annealing, though the tensile strength simultaneously falls, as in No. 17, Table 100, p. 210.

§ 280. EXAMPLES OF WIRE-DRAWING.—Table 116 summarizes the general procedure in certain cases.

The practice in examples 6 to 9 is much better than that in the first five examples, while that in Number 10 is better still.

In drawing the wire for the Woodbridge wire-wound gun, annealed half-inch square open hearth rods of 0·31

[a] § 172, p. 106.
[b] § 178, A, p. 114.
[c] § 182, p. 118.
[d] Ichland, Stahl und Eisen, VI., p. 23, 1886.
[e] U. S. patent, 377,000, Jan. 24th, 1888, J. Withington: Iron Age, XLI., p. 274, 1888: Beckert, Leitfaden zur Eisenhüttenkunde, p. 404, 1885.
[f] Stahl und Eisen, VI., pp. 14, 183, 1886.
[g] Idem, pp. 181, 276. Iron Age, Apl. 1, 1886, p. 25.
[h] Rept. British Ass., 1882, p. 403. Cf. § 270, p. 214.

TABLE 116.—EXAMPLES OF GENERAL PROCEDURE IN WIRE-DRAWING.

	Example 1.	Example 2.	Example 3.	Example 4.	Example 5.
Description of iron.	Bessemer steel of 0·45% carbon, for pins.	Bessemer steel of 0·45% carbon, for fencing.	Bessemer steel of 0·50% carbon, for coppering.	Charcoal iron for telephone wire.	Swedish iron for fine wire.
Initial size.	No. 6 rod.	No. 6 rod.	No. 5½ rod.	No. 6 rod.	No. 4. rod.
Procedure before first draught.	Pickle, wash, dip in flour-water, dry.	Pickle, wash, dip in salt, dry.	Pickle, wash, lacquer, coat, dry.	Pickle (?), wash (?), dip in flour-water (?).	Pickle, wash, dip in hot water, then in hot soda.
First set of draughts, Nos. B. W. G.	8, 9½ (drawn dry).	8½, 10½, 11½, 12½ (drawn dry).	8½, 9½ (drawn dry).	8½, 10, 11, 12 (drawn dry).?	6½, 8½, (drawn dry).
Procedure between first and second sets of draughts.	Anneal, pickle (?), wash (?), dip in flour-water, dry.	Coat with oil or zinc.	Pickle, wash, lacquer, coat, dry.	Anneal, pickle, wash, coat with flour.	Anneal, pickle, wash, dip in flour and lime-water, drain, dry.
Second sets of draughts, Nos. B. W. G	11½, 12½ (drawn dry).	.....	10½ (drawn dry).	13, 14 (drawn dry ?).	10½, 11½, 12½ (drawn dry).
Procedure between second and third sets of draughts.	Anneal, pickle (?), wash (?), dip in flour-water, dry.	.....	Lacquer.	.....	Anneal, pickle, wash, dip in flour- and lime-water, drain, dry.
Third set of draughts, Nos B. W. G.	14, 15½ (drawn dry).	.....	11 (drawn wet).	.....	14, 15½ (drawn dry).
Procedure between third and fourth sets of draughts.	Anneal (?), pickle, wash (?), lacquer.	.....	.....	.....	Anneal, pickle (?), wash, lacquer.
Fourth set of draughts, Nos. B. W. G	15½, 16½ (drawn wet).	.....	.....	.....	16½, 17½, 18½, 19½ (drawn wet).
Procedure between fourth and fifth sets of draughts.	Anneal, pickle, wash, bat, lacquer.	.....	.....	.....	Anneal, pickle, wash, bat, lacquer.
Fifth set of draughts, Nos. B. W. G.	17½, 18½, 19, 19½, 20, 21 (drawn wet).	.....	.....	.....	20½, 21½, 23½, 24½, 27, 28½, 31, 33, 34, 35, 36 (drawn wet).

	Example 6.	Example 7.	Example 8.	Example 9.	Example 10.
Description of iron.	Swedish iron for Western Union telegraph wire.	Bessemer steel of 0·10% carbon, for fencing.	Bessemer steel of 0·10 % carbon, for fencing.	Bessemer steel of 0·10% carbon, for harvester wire.	Swedish iron for fine wire.
Initial size.	No. 4½ rod.	No. 5 rod.	No. 5 rod.	No. 5 rod.	No. 6 rod.
Procedure before first draught.	Pickle, wash, lime-coat, bake.	Pickle, wash, lime-coat, bake.	Pickle, wash, lime-coat twice, bake.	Pickle, wash, lime-coat, bake.	Pickle, wash, lime-coat, bake.
First set of draughts, Nos. B. W. G.	5, 6 (drawn dry).	6½, 7½, 9 (drawn dry).	6½, 8, 9½, 10½, 12 (dry).	6½, 7½, 9 (drawn dry).	In 3 or 4 draughts to No. 12 (drawn dry).
First set of draughts, Reduction %.	4, 8.	13, 12, 13.	.....	13, 12, 13.	.....
Procedure between first and second sets of draughts.	Anneal, pickle, wash, lime-coat, bake.	Muffle, pickle, wash, lime-coat, bake.	.....	Muffle, pickle, wash, lime-coat, bake.	Anneal, pickle, wash, lime-coat, bake.
Second set of draughts, Nos. B. W. G.	7, 8 (drawn dry).	10½, 12 (drawn dry).	.....	10½, 12, 13, 14 (drawn dry).	In 6 draughts to No. 19 (2 draughts dry, then lacquer and draw wet.
Second set of draughts, Reduction %.	1, 8.	14, 14	.....	14, 14, 13, 13.	
Procedure between second and third sets of draughts.	Anneal, pickle, wash, lime-coat, stand for 1 to 7 days, bake, galvanize.	.....	.....	Anneal, pickle, wash, bat, stand in water, immerse in "lees."	Anneal, pickle, wash, bat.
Third set of draughts, Nos. B. W. G.	.....	.....	.....	15, 16, 17, 18, 19, 20 (drawn wet).	20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33 (drawn wet).
Third set of draughts, Reduction %.	.....	.....	.....	13, 10, 11, 16, 14, 17.	9—11—9—11—7—17

Each column represents the procedure in some one case. The numbers in each horizontal line in a given column represent the size of the wire (gauge number) on emerging from passes which succeed each other without intervening treatment: the text indicates the operations between the last pass of the preceding and the first of the following line. Examples 1 to 5 from Freson, Rev. Univ. 2d Ser., XVIII., p. 149, 1885, "Les Tréfileries Américaines." Examples 6 to 10 from the author's notes.

to 0·32% of carbon were reduced to 0·15″ square wire in ten draughts *without annealing*, the corners of the wire being slightly rounded. The wire was coated with lime-flour paste and dried before each draught: after the second draught (and apparently after all subsequent ones) the wire was lacquered before the lime-flour coating was applied. The speed of drawing varied from fifteen feet per minute for the first to twenty-seven for the last draught. The ratios of reduction and the absolute reductions were as follows:

Table 117.—Reduction in Drawing Gun-Wire (Medcalfe).

No. of draught.	Initial size.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Assigned size, inches	0·5	0·445	0·394	0·349	0·310	0·274	0 243	0 215	0·191	0·169	0·150
Reduction, per side. inches	.....	0·055	0·051	0·045	0·039	0·036	0·031	0 028	9·024	0·022	0·019
Reduction, ratio	.....	·89	·885	·886	·888	·884	·887	·885	·884	·885	·888

The dies were 1·75 inches thick: the holes were tapered, about 1 in 5, at the outside face, but square and straight through the inner half of the plates thickness.

Though the wire was of admirable material, there were so many breakages that the scrap and defective wire were estimated at fully ten per cent. of the total weight: hence the conclusion that this is about as severe treatment as iron can successfully endure. (The scrap appears to have been chiefly pieces weighing less than twenty pounds).[a]

§ 281. Protective Coatings.—*A copper coating* is given by dipping the coiled wire in acid, washing this off in water, then immersing the wire for a few seconds in a copper-sulphate solution acidulated with sulphuric acid, when copper precipitates on the iron. The wire is then drawn to brighten it. It is then sometimes again copper-coated and further drawn.

For galvanizing the wire is usually first annealed, *e. g.*, by passing through an iron muffle as at A, in Figure 105.

It passes thence immediately into a bath B of say hydrochloric acid, and thence through a bath of molten zinc in an iron kettle[b] D, thence through a notch finally to a power-driven drum F, on which it is coiled. The scraping pincers may readily be opened, to allow the joint between successive coils of wire to pass. In practice several wires side by side, each guided by its own set of sheaves, G, H, and coiling on its own drum F, pass through these baths simultaneously.

Tinning is usually applied to finer wire which does not need annealing: otherwise the procedure is much the same as in galvanizing. The wire is passed through a bath of acid, thence directly into one of molten tin, thence through pincers which scrape off the excess of tin, thence through a bath of castile-soap water, thence to the drum on which it is coiled. The soap coating is to prevent the wire from turning black. The wire is often further drawn after tinning, to give it a bright coat.

§ 282. Tests for Wire.—Besides the usual tensile tests, wire for rope and many other purposes is tested for flexibility. This property is usually gauged by the number of times the wire can be kinked, as in Figure 107, and straightened. This very crude test evidently offers great temptation for trickery, and must give way to more trustworthy methods, such as that of bending back and forth 180° between round-cornered iron cheek-pieces (Figure 108) which grasp the wire firmly, so that successive bendings

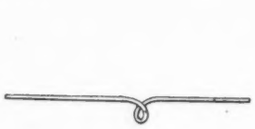


Fig. 107.—Kink-test for Wire

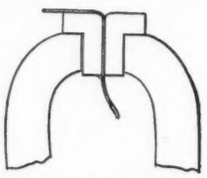


Fig. 108.—Bending-test for Wire.

must occur at the same spot. The free end of the wire is held in pincers, so that rotation of the wire around its own axis may be prevented. Table 118 gives the number of bends required by the German government in case of rope wire.

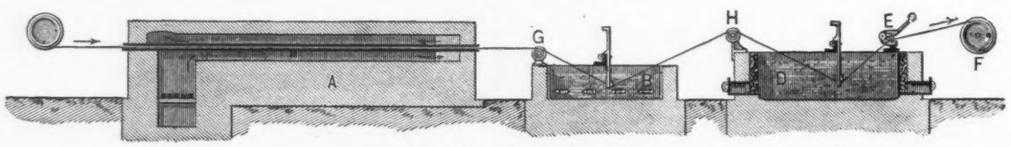


Figure 105.—Galvanizing Plant (Beckert).

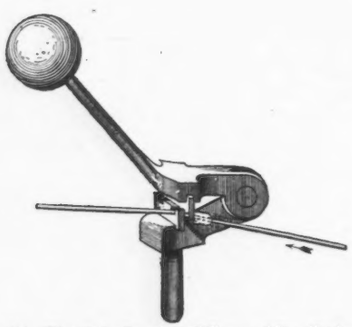


Fig. 106.—Pincers for Scraping off Excess of Zinc (Beckert).

in a pair of pincers E (Figure 105 and Figure 106), in which the excess of zinc is scraped off: thence

Table 118.—Bendings (Figure 108) required by the German Government for Rope Wire.*

Diameter of wire, inches	·122	·11	·098	·079	·070	·062	·055	·039
Size of wire, B. W. G. ±	11	12	12½	14½	15½	16½	17½	19½
Number of bends required: for hard steel	6@7	7@8	8@9	12@14	14@15	15@16	16@17	17@18
Number of bends required: for ingot- and weld-iron	4@6	5@7	5@7	7@8	7@8	8@9	10@12	12@14

* Communicated by Mr. E. Gibbon Spilsbury, Managing Director of the Trenton Iron Company.

COLD-ROLLING AND COLD-DRAWING.

§ 283. In Cold-Rolling[c] the previously pickled bar is passed repeatedly between highly polished chilled cast-iron rollers, the reduction being controlled by frequent calipering. The general disposition of the roll-train is the same as for hot-rolling, but permits unusually accurate adjustment of the rolls. Round bars are rolled over and over in the same groove, and rotated slightly between passes, for of course only a short arc at the top and bottom of the groove can conform accurately to the sec-

[a] Medcalfe, Rept. Chief Ordnance, 1885, pp. 436, 473.

[b] Concerning the zinc-iron alloy which collects in this kettle C F, § 145, p. 84. As the alloy collects at the bottom, the kettle is heated on its sides but not from beneath.

[c] Bernard Lauth, U. S. patent 31,546, Feb. 26th, 1861.

tion aimed at. Thus, at one mill, round bars receive on an average from 30 to 40 passes each, with a total reduction in diameter of about $\frac{1}{32}$ inch when less than three inches in diameter, and about $\frac{1}{16}$ inch when larger.[a] The output from each stand is evidently chiefly dependent on the circumferential velocity of the rolls, and on the accuracy of section aimed at, for great accuracy demands not only very careful calipering but very many passes, with very slight rotation between each pass and the following. In practice extreme accuracy is generally needed, for the round bar must generally be in "wring fit," *i. e.*, it must fit the coupling or other piece which is to receive it so closely that, while it cannot be readily slid or pushed on, it can be wrung on. With section accurate to within $\frac{1}{1000}$ inch, this mill turns out about 1000 running feet, or say 50 bars, per train of rolls per shift.

Freson[b] gives the following details of practice at an American mill. After pickling in liquor composed of ten parts of water and one of sulphuric acid of 60° B, the bars are dipped in lime-water, dried, and rolled repeatedly through a single groove, with reductions of from $\frac{1}{300}$″ to $\frac{1}{100}$″ at a pass There are three roll-trains of the following dimensions:

Table 119.—Trains for cold-rolling at an American Mill.

	Number of stands.	Distance between centres, inches.	Revolutions per minute.	Circumferential velocity, feet per minute.	Product.
1st train.....	4 stands + 1 polishing stand	18″	40 @ 45	188′ @ 212′	Rounds, 1½″ @ 4½″ diameter.
2d train.....	2	12″	40 @ 45	126′ @ 141′	Rounds, ¾″ @ 1½″ diameter.[c]
3d train.....	1	10″	50 @ 60	131′ @ 157′	Rounds, ½″ @ ¾″ diameter.
	1	12″	50 @ 60	157′ @ 188′	Flats and squares.

[c] Given as 5-4″ @ 1½″ in the original, but probably by typographical error.

Some of the details of rolling are as follows:

Table 120.—Cold-Rolling at an American Mill, Concluded.

Diameter of bar, initial, inches	2·56	1·5	0·75
Diameter of bar, final	2·36	1·38	0·63
Reduction of diameter, %	8%	8%	16%
Number of passes	43	30	31
Time occupied, minutes	28	13	15
Men employed	3	3	1, + 1 boy
(Freson's data end here).			
Men × minutes	84	39	22·5

Average men × minutes = 48·5 or 24·25 cents per bar, assuming that eight effective hours work cost $2.40.

The degree to which cold-rolling may be carried is indicated by the results of the following experiments.[c] Thoroughly annealed open-hearth steel bars, apparently containing 0·31 to 0·32% of carbon[d] and 4·5 inches square, were to be reduced to 3·43 inches square in the fewest possible passes. Rolls 22 inches in diameter and 18 inches long were employed. The first pair of rolls tried had a single groove 2·42″ deep (the semi-diagonal of 3·43″) in each roll, with an angle of 91°, and closed with a fillet of 0·17″ radius. The lower roll broke through the bottom of the groove after 24 passes on a 12 foot bar, reducing at the rate of 82 passes per inch (*i. e.* such that 82 passes would reduce the side of the square by 1″) and 6 passes at the rate of 120 per inch. The failure was attributed chiefly to the sharpness of the corners of the bar, which cut into the roll, and this sharpness in turn (A) to the depth of groove, which increased the drag of the bar on the bottom of the groove, (B) to the short radius of the fillet, and (C) to the small angle (91°) of the groove.

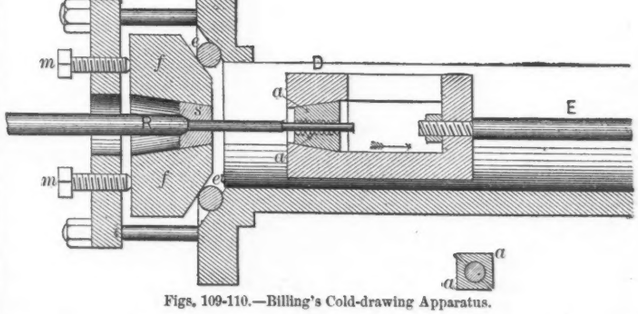
The second pair of rolls had two grooves 1·59″ deep, with an angle of 93°, and a fillet of 0·3″ radius. After rolling five 24-foot bars with a reduction of 109 per inch, the upper roll cracked in two through the bottom of the groove with very little warning, showing a chill 5″ to 6″ deep: the failure was attributed to excessive depth of chill. A third set of rolls, apparently like the second, but with a guaranteed chill of two inches, rolled seven 24-foot bars without mishap or apparent injury, reducing at the rate of from 132 to 140 passes to the inch. These results are here condensed.

Table 121.—Experiments in Cold-Rolling 4½″ Steel Bars.

Expt. No.	Description of rolls. Grooves. No.	Depth.	Angle.	Fillet radius.	Depth of Chill.	Performance.	Passes per 1″ reduction.	Result.
1.	1.	2·42″	91°	0·17″	.....	1 bar { 24 passes. + 6 "	82 120	{ Roll broke.
2.	2.	1·59″	93°	0·30″	5″ @ 6″	5 24′ bars.	109	Roll broke.
3.	2.(?)	1·5″	93°(?)	0.30″(?)	2″ estimate.	7 24′ bars.	132 @ 140	No accident: roll intact.

§ 284. Cold-Drawing.—Previously pickled steel and iron bars, round, square, hexagonal, etc., are drawn cold through a die to strengthen them, raise their elastic limit, polish them, and give them accurately uniform section. The bar in emerging from the die tends strongly to warp, and to lessen this tendency Billings' self-centring apparatus[e] is devised. As this is the best-known apparatus, let it suffice as an example of the general procedure.

The end of the rod R, having been hammered down so that it may pass through the die S, is grasped by the clutch *a*, which is shown in transverse section in Figure 110, and is practically a pair of wedges like those of common iron-testing machines, with semi-cylindrical toothed recesses for grasping the rod. The draw-bar E, moved by a hydraulic cylinder, then pulls the clutch to the right, drawing the bar through the die. In the device shown the die-seat *f* rests on four rollers *e*, and is tipped so as to centre the die by four set-screws *m m*, of which only two are here shown. In another arrangement the die-seat is hung in gimbals on knife-edges, and in still another the spherical-ended die-seat rests in a spherical recess in the draw-bench, forming a ball-joint. In both cases the die may be centered by set-screws as in Figure 109, or may be allowed to centre itself.



Figs. 109-110.—Billing's Cold-drawing Apparatus.

In spite of these expedients the bar usually becomes slightly bent in drawing, the camber in many bars which I have seen varying from nothing to 1·5 inches in 20 feet, estimated by the eye. The bar is next straightened by passing it between three horizontal rollers.

[a] Private communication frem the management, June 27th, 1888.
[b] Revue Universelle, 2d ser., XVIII., p. 338, 1885.
[c] Medcalfe, Rept. Chf. Ordnance, U. S. Army, 1885, p. 469.
[d] Idem, 1884, pp. 432-3.
[e] U. S. patents 130,465, G. H. Billings, Feb. 26th, 1872: 295,898, C. C. Billings, April 1st, 1884. Engineering and Mining Jl., XXXV., p. 222, 1883. Revue Universelle, 2nd ser., XVIII., p. 351, 1885; Stahl und Eisen, VI., p. 177, 1886.

On an output of six tons about ten men are employed: this includes

Two at each drawing press	4
Two straighteners	2
Machinist	1
Pickling	2
Other	1
Total	10

Details.—At an American mill bars from $\frac{5}{8}$ to 3 inches in diameter are thus drawn, of round, square, and other simple sections. The usual reduction is about 1-16 inch, but occasionally as much as 3-16 inch per draught. The total reduction is usually effected in one, but occasionally in two draughts. There are two drawing benches, with hydraulic cylinders 15 inches and 8 inches in diameter respectively, with a stroke of about 23 feet, and with hydraulic pressure of about 600 pounds per square inch. Their capacity, which greatly exceeds that of the rest of the department, is estimated roughly at 20 tons per shift, or rather more if running chiefly on the larger sizes. The engine which furnishes the power is so small that about 2 min. 30 sec. are required to draw bars of the larger sizes, and the return stroke takes 1 min. 30 sec.: add 20 sec. for attaching the clutch, and we have a total of 4 min. 20 sec. Mr. Billings assures me, however, that there is no difficulty in drawing at the rate of 1 min. or even less per draught. The dies are made of hard carbon-steel, which has proved more suitable than Mushet's. In drawing about 2,000 running feet, or 100 bars, the diameter of the die becomes enlarged by about 0·001 inch. It is then slightly closed by heating and hammering, and dressed on a conical emery wheel to the exact size desired. The cost of hammering and dressing each die is estimated at ten cents, or at 0·1 cent per bar drawn.

Cold-Rolling and Cold-Drawing Compared.—The following very rough calculation, necessarily based in large part on estimate, aims solely to compare these two processes, and does not take into account items of cost which are substantially the same in each, such as pickling, straightening, and cutting to length.

I have no direct means of comparing the cost for power, repairs and interest, but from general knowledge of the two processes I believe that it is much higher for rolling than for drawing. Still, let us assume that they are equal, and further let us take the actual time of drawing with the present somewhat tentatively constructed plant and with insufficient power, assuming, however, that operations are on a large scale, so that the time of the men who hammer down the ends of the bars and cut off the ends in lathes is fully employed.

The waste is greater in cold-drawing than in rolling, because the end which is hammered down to enable it to enter the die must be cut off at any rate. Taking this excess at 1·5 pounds per bar, and charging $1\frac{1}{4}$ cents per pound for the difference between the value of scrap and of the bar ready for drawing, we arrive at 1·87 cents per bar as the amount chargeable to cold-drawing.

Debit of cold-drawing, per bar.	Min.	Cents.
Excess of waste		1·87
Hammering down the end of the bar, 1 man 2 minutes	2	
Drawing, 2 men 4·5 minutes	9	
Cutting off the end of the bar, 1 man 2 minutes	2	
Total, minutes	13	
13 minutes at $2.40 per 8 effective hours work = 0·5 cts. per minute		6·50
Cost of dressing die, 10 ÷ 100		0·10
Total debit		8·47
Credit, outlay of labor in cold-rolling, 48·5 minutes, at 0·5 cts.		24·25
Balance to credit of cold-drawing, cents per bar		15·78

So heavy a balance as this can hardly be outweighed by other unknown differences. Indeed, leaving all estimates aside, it is hard to believe that, with equally careful management, the cost of a single draught can equal that of many passes through rolls, increased by the necessity of frequently calipering the bar. Freson seems to think cold-drawing more expensive than cold-rolling[a]: I think he is mistaken.

PUNCHING AND SHEARING.

§ 285. PUNCHING produces in iron a veritable flow, the particles of metal moving away from the approaching punch in their paths of least resistance. The upper surface is drawn down somewhat like the surface of water over a submerged outlet, as shown in Figure 111. Of the metal initially in the path of the punch a part, whose proportion to the whole seems to vary directly as the thickness of the bar and inversely as the diameter of the hole, and which sometimes amounts to 69% of the whole, is forced laterally, bulging the piece, while the rest is driven directly before the face of the punch as a core. The flow and the small proportion which the rejected core bears to the volume of the hole are illustrated in Figure 112. The natural supposition that the pressure gives the ejected core a density greater than that of the mother-block is incorrect. Indeed, D. Townsend found the density of core and block 7·78 and 7·82 respectively, a difference far beyond the limits of experimental error in careful work.[b]

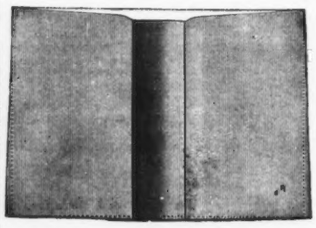


Figure 111.—Flow of Metal in Punching.

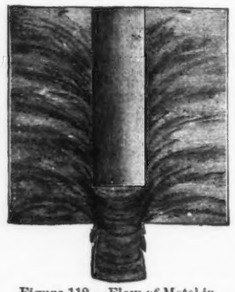


Figure 112.—Flow of Metal in Punching.

Punching usually lowers the strength and ductility of the mother-metal, the loss, at least in case of tensile strength, increasing

1, with the distance of the hole from the edge of the piece, at least in case of soft steel;

2, probably with the proportion of carbon;

3, probably also with the initial hardness of the piece, however caused;

4, with the thickness of the piece; and,

5, as the clearance between punch and die decreases.

The influence of clearance-size seems to decrease with the ratio of width to thickness of bar.

Supporting evidence will be offered shortly.

We can usually remove these effects completely either by heating (whether with fast[c] or slow cooling), or by reaming or countersinking the hole: and perhaps partially, at least in case of thin plates, by hot-riveting, the heat of the rivet causing a partial annealing. But rivet-

[a] Op. Cit., p. 353. "Les Chiffres de la main-d'oeuvre et de l'entretien ont une part plus considérable dans le prix de revient," in cold-drawing than in cold-rolling.

[b] Journal Franklin Inst., CV., p. 145, 1878.

[c] Needless to say, fast cooling sets up new conditions, which, however, are nearly if not quite independent of the previous punching, whose effects are effaced in heating.

TABLE 121A.—PUNCHING: ITS EFFECTS AND THEIR REMOVAL BY REAMING AND BY ANNEALING.

Number.	Authority.	I. Description of punched test-piece. Dim'nsions inches. Width.	Thickness	Carbon %.	Punching conditions. Dim'nsions, inches. Punch, diam.	Clearance.	II. Original untreated metal. Tensile strength, pounds per square inch.	Elongation. %	Inch's	III. Drilled metal, unpunched. Diameter of drilled hole, in.	Dim'nsions of drilled test-pieces, inches. Width	Thickness.	Tensile strength pounds per square inch.	Elongation %	Percentage of gain of tensile strength by drilling.	IV. Punched metal not treated further. Tensile strength pounds per square inch.	Elongation %	Percent'ge of gain (+) or loss (−) of tensile strength relative to Solid metal.	Drilled metal.	V. Punched Metal reamed. Thickness of reaming, inches.	Tensile strength pounds per square inch.	Elongation %	Percent'ge of gain (+) or loss (−) of tensile strength relative to Solid metal.	Drilled metal.	Diameter of reamed hole inches.	VI. Punched meta annealed. Tensile strength per square inch.	Elongation %	% of gain (+) or loss (−) of tensile strength relative to solid metal.
1	Ba.	1·95	.....	.....	·66	·02	.....	.....	..	.....	.....	.....	.....	.....	.....	57,994	.....	.....	.....	·039	72,195	.....	.....	.....	·738			
2	"	2·34	0·31	.....	·63	.....	.....	.....	..	·70	2·34	0·31	69,933	.....	.....	.....	.....	.....	.....	·035	67,648	.....	.....	— 3·27	0·70			
3	"	1·75	0·46	.....	0·66	.....	.....	.....	..	·66	1·75	·46	77,616	.....	.....	62,227	..	.....	— 19·84	·04	76,205	.....	.....	— 1·82	0·66			
4	"	2·34	.....	.....	·66	.....	.....	.....	..	·66	...	.....	99,770	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	96,925 hard'n'd		
5	"	1·95	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	67,222	.....	.....	54,858	.....	.....	— 18·39	.....	.....	.....	.....	.....	.....	66,080		
6	"	2.34	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	61,802	.....	.....	49,034	.....	.....	— 20·66	.....	.....	.....	.....	.....	.....	74,794 hard'n'd		
7	"	2.34	.....	.....	·66	.....	.....	.....	..	·66	...	.....	77,190	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	55,710	10·3	— 3·09
8	K.	....	·129	·15	·77	.....	74,915	10·8	10	·77	.....	.....	81,050	5·7	8·2	72,470	3·2	— 3·39	— 10·59	.....	.....	.....	.....	.....	.....	53,450	14·6	— 2·00
9	"	....	·250	·15	·77	.....	60,480	28·2	10	·77	.....	.....	66,950	14·1	10·7	59,870	9·6	— 1·01	— 10·58	.....	.....	.....	.....	.....	.....	50,470	18·1	— 1·18
10	"	....	·380	·15	·77	.....	51,456	36·1	10	·77	.....	.....	57,280	17·2	11·3	51,680	13·5	**+0·40**	— 9·79	.....	.....	.....	.....	.....	.....	51,840	19·3	**+0·98**
11	"	....	·495	·15	·77	.....	55.803	36·4	10	·77	.....	.....	63,120	18·7	13·1	44,220	3·2	— 20·75	— 29·95	.....	.....	.....	.....	.....	.....	50,040	20·7	— 0·79
12	"	....	·625	·15	·77	.....	52,924	37·2	10	·77	.....	.....	59,030	19·0	11·5	38,970	1·9	— 26·35	— 33·98	.....	.....	.....	.....	.....	.....			
13	G.	2·00	·510	.12	·69	.....	64,200	25·15	8	.....	.....	.....	.....	.....	.....	55,000	.....	— 14·33	.....	·03@ ·18	65,560	.....	**+2·12**					
15	Be.	.....	.....	.....	·75	.....	.....	.....	..	·75	.....	.....	.....	.....	.....	.....	.....	— 6·5	.....	·06	.....	.....	+5·9	.....	·75			
16	B.	8.	·812	.....	1·09	.....	62,720	.....	..	1·09	8·	·812	69,216	.....	10·4	47,376	.....	— 24·47	— 31·55							66,080		
17	BG.	1.	·5&	.12	·5	.....	65,363	24·38	8	·5	1·	·5&	63,370	5·19	— 3·05	57,366	2·88	— 12·24	— 9·47	·06	66,259	4 88	**+1·4**	+ **4·6**	.....	65,811	4·95	
18	"	1.	·625	·3@·5	·5	.....	121,856	13·56	8	·5	1·	·625	98,896	0·76	— 18·84	72,240	0·39	— 40 72	— 26·95	·06	105,571	0·64	—13·36	+ **6·8**	.....	107,811	0·88	
20	W.	....	·36	.....	·75	.....	59,360	22·	8	.....	.....	.....	.....	.....	.....	61,600	3·	.....	.....	·10	72,800	4·	.....	.....	.....	64,960	6·	
21	"	....	·26	.....	·62	.....	72,128	20·5	8	.....	.....	.....	.....	.....	.....	61,600	1·	.....	.....							75,712	3·	
22	"	....	.....	.....	·875	.....	66,528	23·5	8	.....	.....	.....	.....	.....	.....	58,240	2·	.....	.....	·12	72 240	4·	.....	.....	.....	71,680	4·	
23	P.	....	·7	±	1·12	·03	60,592	.....	..	1·12	.....	·675	64,355	.....	.....	51,341	.....	— 17·8	.....	·12	64,534	.....	.....	.....	1·12	64,915		
24	"	....	·7	.....	1·1	·12	62,474	.....	..	.....	.....	.....	.....	.....	.....	54,791	.....	— 12 3	.....	·14	57,546	.....	— 7·9	.....	1·15			
25	"	....	·7	.....	1·	·17	62,474	.....	..	.....	.....	.....	.....	.....	.....	47,130	.....	— 24·5										
27	"	....	·75	.....	·1·09 ·1·08	·04 ·08	59,136	.....	..	.....	.....	.....	.....	.....	.....	·44,800 ·41,866	.....	·—24·2 ·—28·7	.....	·12	63,168	.....	+ 6·8	.....	1·12	71,080		
30	Ba.	2·34	.....	.....	·74	.....	.....	.....	..	·74	.....	.....	37,946	.....	.....	33,264	.....	.....	— 12 34	·04 ·08	35,526 38,528	.....	.....	.....	·74 ·74			
31	Be.	...	.....	.....	·75	.....	54,970	.....	..	·75	.....	.....	56,582	.....	+ 2·9	43,747	.....	—20·5	— 22·68	·06	56,627	.....	+3.	+1·50 +0·10	75			
32	T.	....	.....	.....	·31	.....	59,820	.....	..	·31	.....	.....	59,240	.....	+ 3·0	48 120	.....	—19·6	.....	·04	58,380	.....	—3·8	.....	·35	57,930	...	— 3·4
33	"	....	.....	.....	·47	.....	60,830	.....	..	·47	.....	.....	65,020	.....	+ 8·6	51,300	.....	—15·7	.....	·04	61,990	.....	+2 1	.....	·51	61,130	.....	+ 0·5
34	"	....	.....	.....	·63	.....	61,550	.....	..	·63	.....	.....	69,070	.....	+ 11·9	52,890	.....	—14·1	.....	·04	64,740	.....	+7·4	.....	·67	63,730	.....	+ 3·5
35	"	....	.....	.....	·78	.....	60,690	.....	..	·78	.....	.....	67,630	.....	+ 9·3	54,480	.....	—11·4	.....	·04	65,170	.....	+8·1	.....	·83	64,440	.....	+ 6·2
36	...	...	.....	.....	.....	.....	.....	.....	..	.....	.....	.....	.....	.....	+ 8·2	.....	.....	—15·2	.....	.....	.....	.....	.....	.....	.....	.....	.....	+ 1·7
37	P.	....	·76	±	1·08	·05 ·08	44,62$_1$	.....	..	1·14	.....	.....	42,806	.....	— 4·0	·35,616 ·34,922	.....	·—20 ·—22	.....	.....	.....	.....	.....	.....	1·16	42,851	...	— 4.
38	"	....	·74	.....	1·1	·08 ·11	52,23$_7$	.....	..	1·13	...	·74	50,557	.....	— 8·	·40,746 ·42,403	.....	·—18·8 ·— 8·8	.....	·13	47,421	...	—9·2					

1 to **7,** Barba, Holley, Use of Steel; 1 to 5, Terre Noire Bessemer steel plates; 6 and 7, La Creusot open-hearth steel plates.
8 to **12,** Kirkaldy, Experiments on Fagersta Steel, Series 2. Bar 12·5 inches wide had three rows of five 0·77-inch holes punched across them, thus removing 30·8% of the width of the piece.
a The percentage of loss for column VI, is obtained by comparing the punched-annealed with the solid annealed metal, because the metal, which was unannealed when punched, is weakened greatly by annealing
To avoid complicating the Table, I omit the properties of the drilled-annealed metal.
13, Gatewood, Rept. U. S. Naval Advisory Bd. on Mild Steel, 1886, p. 170. The results under punched metal reamed refer to punched metal countersunk through. When the countersinking was stopped.
15. P. D. Bennett, Journ. Iron and St. Inst., 1886, I., p. 373, from Proc. Inst. Mech. Eng., 1886, pp. 44-61.
16, Boyd, Jeans "Steel," from Proc. Inst. Mech. Eng., 1878.
17, 18, Beck-Guerhard "On the Influence of Punching Holes in Soft Steel," 1884, Russian Mining Jl. My statements are based on a translation sent Mr. T. Cooper by the author. Journ. Iron and Steel Inst., 1884, I., p. 290, has an abstract, with many incorrect numbers. No. 17 is the mean of six sets of results, No. 18 of two sets.
20 to **22,** Basic Bessemer steel: White, "On some Recent Experiments with Basic Steel," Excerpt Trans. Inst. Nav. Arch., 1887, p. 15.
23 to **27,** Parker, Trans. Inst. Nav. Arch., XXVII., p. 418, 1886. From Rept. for Lloyds Register, March 20th, 1878. 23–5, Cammell's Steel; 27 Bolton Steel:
30, Barba, Op. Cit., p. 45. Wrought-Iron Plates.
31. Bennett, Loc. Cit., Wrought-iron.
32–5, Lowmoor Wrought-Iron Plates, Tetmajer, Stahl und Eisen, VI., p. 173, 1886. All except the drilled specimens were cut from the same plate. The gain of tensile strength due to drilling is obtained by comparing the drilled pieces with untreated pieces from the same plate, whose properties I do not give.
37, 38, Parker, Loc. Cit., 37, Seaward's best best iron boiler-plates; 38, Cammell's best best iron plates.

TABLE 122.—EFFECTS OF PUNCHING.

	Dimensions of test-pieces, etc. Width, inches.	Thickness, inches.	Conditions of punching. Diameter, inches Of punch.	Of die. Conical.	Cylindric'l	Tensile strength, pounds per square inch. Of untreated metal.	Of drilled test-piece.	Of punched test-piece. Conical punching.	Cylindrical punching.	% loss of tensile strength on punching relative to Solid piece. Conical punching	Cylindrical punching.	Drilled piece. Conical punching.	Cylindrical punching.
1..	1·24	0·27	0·66	0·82	0·76	.....	.....	71,075	60,480	+ 2·4	—12·9		
2..	1·95	.....	.....	0·82	0·76	.....	.....	63,235	57,994	— 8·9	—16·48		
3..	2·65	.....	.....	0·82	0·76	69,440	.....	58,845	56,560	— 15·3	—18·55		
4..	3·35	.....	.....	0·82	0·76	estimated	.....	49,974	56,736	— 28·0	— 26·94		
5..	4·05	.....	.....	0·82	0·76	.....	.....	51,318	54,275	— 26·1	— 21·84		
6..	4·75	.....	.....	0·82	0·76	.....	.....	53,155	51,722	— 23·4	— 25·52		
7..	5·24	·25	·69	·74	.....	71,837	.....	66,035	.....	8·1			
8..	.....	·375	·84	·94	.....	66,292	.....	53,894	.....	18 7			
9..	.....	·47	± ·97	1·11	.....	64,915	.....	47,891	.....	26·2			
10..	.....	·593	·96	1·1	.....	66,192	.....	43,837	.....	33·8			
11..	.....	0·5	0·69	0·87	0·75	.....	.....	72,867	58,240				
12..	.....	·69	1·12	.....	.....	.....	61,376	40,544		.....	.....	— 33·94	
13..	1	·39	·59	.....	·70	.....	67,200	60,032		.....	.....	— 10 67	
14..	1·2	·28	·59	.....	·70	.....	67,424	59,360		.....	.....	— 11·96	
15..	.....	·45	·875	.....	.....	62,922	.....	63,213					
16..	1·24	.....	0·66	0·81	.....	39,715	.....	37,654	.. ..	— 5·2			
17..	1·95	.....	.....	.....	.....	"	.....	37,386	.....	— 5·9			
18..	2·62	.....	.....	.....	.....	"	.....	33,824	.....	—14·8			
19..	3·35	.....	.....	.....	.....	"	.....	32,973	.....	—17·0			
20..	4·05	.....	.....	.....	.....	"	.....	33,130	.....	—16·6			
21..	5·26	1·16	± 1·12	1·37	1·25	41,620	± 41,620	37,878	34,956	— 9·	± — 16·0	± — 9	— 16·0
22..	1·27	·375	·52	.....	·52	.....	97,76·	111,800		.....	.....	+ 14·40	
23..	1·02	·625	·52	.....	·52	.....	57,020	60,190		.....	.....	+ 5·60	
24..	·89	·625	·52	.....	·52	.....	57,650	64,100		.....	.....	+ 11·20	
25..	·77	·625	·52	.....	·52	.....	60,580	71,800		.....	.....	+ 18·50	

1 to **6,** Barba, Holley, Use of Steel, p. 29. Terre Noire Bessemer steel plates.
7 to **10,** Parker, Trans. Inst. Nav. Arch., XXVII., p. 421, 1886, from Report to Lloyd's Register, 1878. John Brown's steel.
11, Sharp, idem, 1868, p. 10.
12, Boyd, Jeans, Steel, p. 735, from Proc. Inst. Mech. Engineers, 1878
13, 14, Jeans, Steel, p. 840. Steel plates from the John Cockerill Works, Seraing. 20, unannealed plates: 21, annealed plates. Each result is the mean of two.
15, Parker, op. cit. Steel from Motala Works, Sweden.
16 to **20,** Barba, op. cit., p. 44. Wrought-iron plates.
25, Kirk, Trans. Inst. Nav. Arch., 1877, p. 303, wrought-iron plates.
22 to **25,** Hoopes and Townsend, private print, p. 66. This series differs from series 1–6 and 20 to 24, in that the bars were of uniform width, 1·375 inches, when punched, their width being reduced after punching: while in the other series the bar was cut to the width stated before punching. The results are surprising, the more so as the punch fitted the die accurately, a condition which in other cases produces the greatest injury. Messrs. Hoopes and Townsend are makers of cold-pressed nuts, and offer these results as evidence that cold-punching does not injure but improves iron. Each result is the mean of two.

ing may be expected in some cases to increase rather than lessen the effects of punching (§ 288). The results of many experiments are summarized in Tables 121A to 123.

TABLE 123.—EFFECT OF PUNCHING AND SUBSEQUENT REAMING ON SOFT INGOT-STEEL. HILL.

Carbon, %.	Size of test piece, inches.		Tensile strength in pounds per square inch, and % of elongation in 18 inches.											
			Unpunched.		With a hole 0·75in. in diameter punched, or punched and reamed.									
					Unreamed.		·02″ radius reamed.		·03″ radius reamed.		·04″ radius reamed.		·05″ radius reamed.	
	Width.	Thickness.	Tensile strength.	Elongation.	Tensile strength.	Elongation.	Tensile strength.	Elongation.	Tensile strength.	Elongation.	Tensile strength.	Elongation.	Tensile strength.	Elongation.
·30	2 in.	·25	79,200	20·2	62,400	5·6	86,600	19·0						
"	"	·37	83,300	19·0	60,800	5·0	85,000	17·9						
"	"	·50	88,400	17·3	59,100	4·7	83,200	11·2	88,900	16·0				
·40	"	·25	82,900	18·5	66,100	5·1	84,100	18·6						
"	"	·37	86,500	15·9	64,800	4·9	79,300	11·3	87,200	13·0				
"	"	·50	89,800	13·0	61,300	4·0	65,100	4·3	77,400	6·6	90,300	11·7		
·50	"	·25	83,700	14·7	74,900	5·4	76,100	5·3	83,900	13·9				
"	"	·37	88,500	13·1	71,200	3·0	74,100	4·1	79,900	8·7	88,800	11·9		
"	"	·50	91,800	11·4	69,300	2·5	70,900	2·0	73,700	3·0	81,400	4·7	92,300	10·0

Trans. Am. Inst. Mining Engineers, XI., p. 259, 1883.

From around the holes in steel plates, some punched, some drilled, Barba cut rings about 0·19 inches thick, Figure 113. Those from drilled holes A, B, C, could be completely flattened without cracking, and only cracked when partly reopened. They were no harder than the mother-metal. Those from punched holes cracked and broke when bent, as shown at D and E respectively, were harder under the file, and scratched their mother-metal. But if the punched hole first had 0·039 inches reamed from its sides, the ring now obtained could be completely flattened and brought back to the shape of Figure G before cracking. Again, rings cut from unreamed punched holes could, after annealing, be flattened and brought back to the shape of figure I before cracking; in other cases they were cut on a generating line, completely developed, and bent back as in Figure J so as to extend the original interior, without perceptible crack, though with further deformation cracks appeared.

But punching may be harmless or even beneficial. Thus Guerhard found that, under given transverse load, fourteen punched soft-steel fish-plates deflected 2·8% less temporarily and 3·1% less permanently than fourteen similar

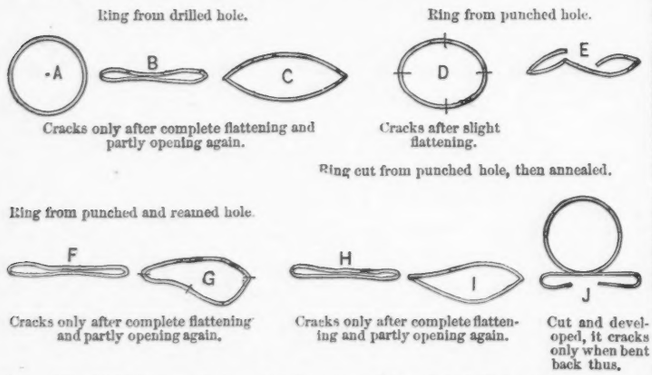


Figure 113.—Malleableness of Rings Cut from Around Punched, Drilled, and Reamed Holes. Barba. Three-fourths natural size.

drilled plates. Thurston found the stripping and bursting strength of many cold-punched wrought-iron nuts much greater than those of similar but hot-pressed nuts, the former excelling the latter in bursting strength on an average by 44% when blank and by 22% when tapped.[a] In Table 122, numbers 22 to 25 are reported to gain strength on punching.[b] Cooper found that the punched holes in soft steel and wrought-iron plates endured as much distortion by drifting as similar punched and reamed holes. As reaming removes the effects of punching one might infer that punching had not lessened the ductility of the metal around the holes. But a quite different explanation is offered in § 288. His results follow.

TABLE 124.—PERCENTAGE OF ELONGATION OF HOLES WHEN DRIFTED TILL THE METAL BEGINS TO CRACK.—(COOPER).

	⅜″ steel plates.			⅜″ iron plates.			⅜″ steel angles.			⅜″ iron angles.		
	Max.	Min.	Avge.	Max.	Min.	Avge.	Max.	Min.	Avge.	Max.	Min.	Avge.
Punched.....	123	54	97	54	54	54	115	92	100	36	36	36
Punched and reamed.....	100	93	106	46	46	46	106	33	73	24	24	24

The steel was very soft, its tensile strength being 55,000 lbs. per sq. in. The holes were enlarged by forcing a long tapered drift into them by sledging. Theodore Cooper, private communication, Sept. 7th, 1888.

Thousands of punched steel boiler-plates have been long in use, with relatively few mishaps. The boiler-plates of the United States vessels Boston, Atlanta and Dolphin were punched, those of the Chicago drilled: up to September 1st, 1884, only seven failures had occurred among the first three collectively, against eight among the last.[c]

§ 286. SHEARING produces effects similar to those of punching, and doubtless acts in similar way. Barba[d] found that soft steel strips, with one edge punched, the other sheared, when bent cracked at both edges under the same degree of distortion. The tendency to crack on the sheared as well as on the punched edge was removed by heating, whether with slow or quick cooling. Goodall found the metal lying within 0·03 inches ($\frac{1}{32}$″) of the sheared edge of a steel plate as malleable as that of the unsheared plate; thus the effects of shearing, like those of punching, are restricted to a very thin shell.[e]

The effects of shearing and their removal are illustrated in Tables 16, p. 27, and 125.

TABLE 125.—EFFECT OF SHEARING AND COLD-HAMMERING AND OF SUBSEQUENT ANNEALING ON SOFT INGOT-STEEL. HILL.

Preparation of test piece. (All pieces ⅜″ × 2″ × 18″.)	·3% C.	·4% C.	·5% C.	·3% C.	·4% C.	·5% C.	·3% C.	·4% C.	·5% C.
	Tensile strength, pounds per square inch.			Elastic limit, pounds per square inch.			Elongation % in 18 inches.		
Cut in planer.....	86,720	89,880	93,210	45,170	53,640	62,070	19·1	16·4	11·4
Sheared out.....	69,376	75,400	82,930	31,290	41,250	49,960	11·3	8·3	5·2
Sheared, then annealed.....	84,950	86,320	92,560	44,830	51,470	59,390	20·2	16·7	12·0
Hammered cold.....	85,380	87,560	91,810	63,720	64,180	71,630	3·4	2·3	·7
Hammered cold, then annealed...	82,970	85,890	90,620	46,360	51,710	65,120	16·8	14·1	8·1

Trans. Am. Inst. Mining Engineers, XI., p. 259, 1883.

§ 287. DISCUSSION.—Now for evidence of the influence of the five variables noted at the beginning of § 285.

That of the first is shown in numbers 1 to 6 and 16 to 20 of Table 122. In each of these sets, width alone varying, the loss of strength on punching increases with it. Barba found this true not only of steel but of wrought-iron: of the latter Barnaby[f] found the reverse true, while agreeing with the other observers as regards steel.

That of the second is shown by the smaller percentage of loss in case of wrought-iron than of ingot-metal. But

[a] Hoopes and Townsend, private print.

[b] I deem it proper to state that these results are published by interested persons, and that the tests are not described so fully as to indicate whether full precautions were taken to make them comparable. Personally I believe that they are true.

[c] Gatewood, Rept. U. S. Naval Adv. Bd. Mild Steel, 1886., pp. 77-8.

[d] Op. cit., pp. 36-8.

[e] H. Goodall: Excerpt Proc. Inst. Civ. Eng., XCII., p. 13, 1888. Also Iron Age, XLI., p. 196, 1888. The malleableness was estimated by the distance through which a given drift-pin could be driven at fixed speed through washers cut from the steel plates, before splitting them.

[f] Jour. Iron and Steel Inst., 1879, I., p. 49.

(TO BE CONTINUED.)

in case of ingot-metal of different percentages of carbon, though the results of general experience seem to support my statement, it is not readily verified from the evidence I offer. Of numbers 17 and 18 in Table 121A, the latter, the richer in carbon, is also the more injured: but in Table 123 the reverse is true. It is uncertain whether this is due to some unnoted variable (different proportions of manganese, silicon, phosphorus, different previous heat-treatment, or what not), or whether the injury, increasing as the carbon rises from ·10 to ·30% decreases with further rise of carbon from ·30 to ·50%. While further investigation alone can decide, I incline to the former as the more probable explanation.

The third is offered as a matter of general experience, not supported by direct experimental evidence. Indeed, number 20 of Table 122 suffers slightly more than number 19, from which it seems to differ only in being annealed before punching.

That of the fourth is shown by numbers 8 to 12 of Table 121A, among which the injury increases with the thickness, which is the only variable. Parker, too, found that, as the thickness of the plates rose from ·375 to ·5 and ·625 inches ($\frac{3}{8}''$, $\frac{1}{2}''$ and $\frac{5}{8}''$ respectively), the loss of tensile strength on punching rose from 18% to 26 and 33%.[a]

That of the fifth is shown by numbers 1 to 6, 11 and 21 of Table 122. In each of these cases we have two experiments, differing only on the width of die or bolster: in all but two cases the wider die gives the smaller loss.

The influence of the greater clearance diminishes in numbers 1 to 6 with ratio of thickness to width, apparently disappearing when a width of 3 35 inches is reached. In number 21 this influence is again seen, though the bar is 5·26 inches wide, the greater thickness here apparently compensating for the increased width.

Turning now to the removal of the effects of punching, first note that in numbers 8 to 12, 15, 16, 31, and 32 to 5 of Table 121A the drilled piece is stronger than the untreated metal. This seems to fall under the general law that, for given section, the tensile strength of very short and especially of grooved pieces exceeds that of long ones,[b] in turn due to the more favorable disposition of the material in the grooved piece with regard to the lines of stress, rather than to the smaller chance of flaws existing in the short piece, for after the length increases beyond a certain point the decrease of tensile strength is less marked. Hence, in weighing the relative advantages of punching and drilling for most purposes, the properties of punched should be compared with those of drilled rather than of solid metal. Why the drilled is weaker than the solid metal in number 17 18, 37 and 38 of Table 121A is not clear.

The Influence of Heating is shown in column VI. of Table 121A. In every case in this column the punched metal, after heating, nearly or quite (as in 17 and 18) equals the drilled. In numbers 8 to 12 the properties of the annealed punched metal are compared with those of drilled and annealed metal, for the annealing itself greatly lowers these as well as those of the solid metal. In 4 and 7 the metal is quenched, in the other cases slowly cooled. Clearly it is the heating, not the rate of cooling, that restores the lost strength.

After Reaming (Col. V., Table 121A) the strength of the punched piece usually nearly equals or even excels that of both solid and drilled metal. Even when, as in numbers 2 and 32 to 35 only 0·03 to 0·04 inches is reamed from the sides of the punched holes, the restoration is nearly or even quite complete. But in Table 123 it appears that the thickness which must be reamed to remove the injury increases with the proportion of carbon and with the thickness of the plate, so that while a $\frac{1}{4}$-inch plate containing 0·30% of carbon is completely restored by reaming ·02 inches, to restore a $\frac{1}{2}$-inch plate containing 0·50% of carbon ·05 inches must be removed. Gatewood found that countersinking, even if carried through only three-quarters of the thickness of the plates, removed about three-quarters of the injury due to punching.

In harmony with the effect of reaming punched plates is that of tapping cold-punched nuts, which removes about half the effect of the punching. (§ 287.)

The local nature of the injury is also shown by experiments by Barba[c] and by Beck–Guerhard,[d] in which they punched holes in steel plates, and then cut and tested strips from these plates, some in close proximity to the punched holes, others farther away: both found the metal's tensile strength and elongation as great near the hole as far from it. Indeed, certain features of Guerhard's results suggest that the metal around the hole near the hole was somewhat strengthened.

TABLE 126.—PROPERTIES OF STRIPS FROM PREVIOUSLY PUNCHED STEEL PLATES, THE STRIPS CUT AT VARIOUS DISTANCES FROM THE PUNCHED HOLE.

B = Barba, G = Guerhard.

Position regarding hole.		Farthest.	Nearer.	Nearer.	Close to.	Near.	Farther.	Farther.	Farthest.
Tensile strength, pounds per square inch	B...	69,664	70,582	68,768	68,970				
	G...	60,435	57 030	60,928	61,443	61,958	61,981	57,434	63,218
Elongation, %	B...	21	21·5	21	21				
	G...	22·7	19·0	19·0	23·0	20·4	26·8	19·54	19·09

In Barba's experiments, one edge of the strip nearest the hole lay only 0·09 inches from the edge of the hole.

Doubtless, a certain flow occurs at considerable distances from the hole. On the surface of plates highly polished before punching, Guerhard noticed gently curving, eyelash-like lines, convex, felt by the fingers, running outwards for nearly two inches from the edge of the hole, making an angle of 45° with tangents drawn through their points of departure, and readily removed by acid. Cooper had previously described similar lines in the scale surrounding holes punched in iron.[e] Again, punching bulges the neighboring edges of plates, etc., though they lie at some distance from the edge of the punched hole. But the evidence already given shows that the action which causes this far-reaching flow does no considerable injury beyond a narrow ring.

Riveting, in Parker's experiments, increased the strength of punched steel plates $\frac{7}{16}$-inch thick by about 4000 pounds per square inch, or say 6%, but it did not improve punched $\frac{3}{4}$-inch plates

In Bennett's experiments, parallel with numbers 15 and 31 of Table 311, riveting reduced the loss of strength due to punching from 20% to 10% in case of wrought-iron, but did not benefit steel.

In Snelus' experiments, punched unannealed riveted

[a] Proc. Inst. Naval Architects, 1878. Also Jeans, "Steel," p. 734.
[b] Compare Rept. U. S. Board on testing iron, steel, etc., I., p. 91 et seq.
[c] Op. cit. in note to No. 17, Table 121.
[d] Op. cit.
[e] Trans. Am. Soc. Civ. Eng., VII, p. 174, 1878.

joints were much weaker than the punched and annealed and than the drilled joints.[a]

The following experiment of Baker's[b] shows so serious a loss of strength in riveted punched plates that, though the strength of the unriveted punched plate is not given, it is probable that riveting annealed but slightly.

TABLE 127.—RESTORATION BY RIVETING. BAKER.

Description of piece.	Solid.	Punched and riveted.	Drilled and riveted.	Punched and annealed.
Tensile strength	73.158	67,603@68,633	77,213	79,228
Elongation in 8 in.	22	3·1@2·2	6·2	6·2

J. Ward reports the following results:[c]

	Tensile strength, Pounds per sq. in.	Elongation, Inches.
Untreated plate	66,304	0·15
Drilled plate	71,232	0·24
Punched plate	62,720	0·15
Punched and riveted plate	69,440	0·15
Punched and galvanized plate	62,048	0·09
Punched, galvanized and riveted plate	65,520	0·11

These results, collectively, give little reason to believe that riveting removes materially the effects of punching.

Clearly, the available heat offered by the rivet, both heads included, bears a higher ratio to the volume of the ring to be annealed in thin than in thick plates.

§ 288. RATIONALE OF THE EFFECTS OF PUNCHING AND OF THEIR REMOVAL.—The complete restoration of punched plates by annealing, and the extreme endurance of distortion and the malleableness conferred by annealing on the initially brittle rings cut from around punched holes, show that punching does not usually act chiefly through causing incipient cracks. The restoration by reaming and other evidence indicates that the serious direct injury is confined to a very small ring. Evidently the metal in this ring is distorted and subjected to great pressure in punching: these are the essential conditions of cold-working: after punching it shows the usual characteristics of cold-worked iron, hardness, extreme brittleness, and, if we may judge from the lightness of the punched core, lower density than the hot-worked metal. That the tensile strength of this ring is also very high, like that of other cold-worked iron we infer from the much greater stripping and bursting strength of cold-punched than of hot-pressed nuts, the stress in both stripping and bursting falling in undue proportion on the metal within this ring: and further from the fact that the excess of bursting strength of the cold-punched over the hot-pressed nuts is far greater when they are blank than when tapped, the tapping removing a part of this strong ring.

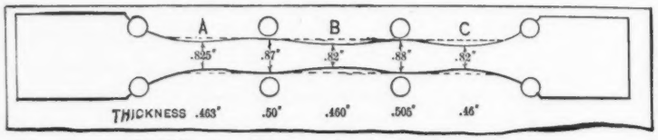
We may thus conjecture that punching acts directly through cold-working this narrow ring, giving it much higher tensile strength and elastic limit but much lower ductility than the surrounding metal, which is probably affected in the same way but to a much lower degree. Punching in this view increases the average strength of the different layers taken individually, giving, however, a heterogeneousness of strength, elastic limit and ductility, which may be a source of strength or weakness, according to the conditions of stress, as pointed out in § 269.

In complete harmony with this view are the following observations of J. Ward.[d] In each of fourteen pairs of tests, apparently representing seven mild steel plates, (tensile strength about 65,000 lbs., elongation about 25% in 8″) the elongation of the test-piece cut from between rows of punched holes as in Figure 114 fell below that of similar test-pieces from untreated parts of the same plates, by from 1 to 8% of the initial length (eight inches), the average difference being 3·2%. But in only six out of the fourteen pairs was tensile strength of the test-piece from between holes greater than that of the untreated metal. In three out of four cases like test-pieces cut from between drilled holes, had less elongation than those from the untreated metal: this, however, seems to be an accidental variation.

In short, the strips cut from between punched holes had the same strength as the untreated metal, but stretched less.

Now, a glance at Figure 114 makes this clear. The metal near where the punched holes have been stretches less than the rest, presumably because its elastic limit has been raised by the cold-distortion during punching. Thus the elongation of the test-piece as a whole is lessened: but its tensile strength is not affected: for the tensile strength of the test-piece is that of its weakest section, to wit, the non-cold-worked parts A, B and C.

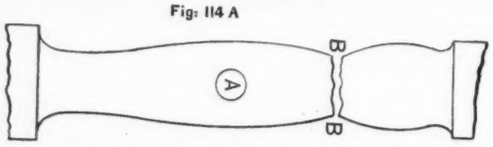
Fig. 114



Local Elevation of the Elastic Limit by Punching. Ward.

Further corroborative of this view are the results of experiments of Barba's in which steel strips 0·46″ thick, Figure 114 A, were punched *partly* through at A, the punch being arrested when it had penetrated 0·39″, and so that 0·07 inches thickness remained. "No hole was completely taken out." The strips "dressed on their whole surface" when pulled yielded least in the region partly punched, rupture occurring at B where the punch had not acted.[e] Here the strengthening effect of the cold-working outweighs the weakening effect of heterogeneousness.

Fig. 114 A



Strengthening Effect of Interrupted Punching. Barba.

But on drilling a hole in the middle of the partly punched region and thus removing its very strongest part, this balance was reversed, and the strength of the remaining section was found to be less than that of the untreated metal.

If it be true that the injury caused by punching is due to heterogeneity of strength, etc., due in turn to the cold-working of this ring, restoration by reaming becomes a matter of course, and by annealing a natural consequence, since annealing, if thorough, removes the effects of all forms of cold-working, solution of continuity of course excepted.

Regarding iron as a viscous liquid, the normal pressure EF of the punch is communicated in all directions, but more and more feebly as the direction departs from that of EF. In conical punching the direction of the pressure which

[a] Kirkaldy, Snelus, Journ. Iron and Steel Inst. 1879. II., pp. 642-3.

[b] The Use and Testing of Open-hearth Steel, etc., Excerpt Proc. Inst. Civ. Eng. XCII., p. 47. 1888.

[c] Trans. Inst. Nav. Arch. XXVII., 1886, p. 121. Each number is the mean of six results.

[d] J. Ward, Trans. Inst. Nav. Arch., XXVII., pp. 106-114, 1886.

[e] The Use of Steel, Barba, Holley, p. 55. I understand that this dressing on the whole surface was carried so far as to remove all visible distortion, whether depression, spreading, or otherwise, due to the punching, leaving the test piece of uniform cross-section. Holley's translation to which alone have I had access, states that the strips were 0·46″ *wide*, and the punch 0·74″ in diameter; but judging from the figure and description, it must mean 0·46″ thick.

falls on AB and CD is farther removed from that of EF than in cylindrical punching: clearly the tendency to force the metal from the block ABCD into the surrounding metal, and hence the pressure against AB and CD are less in Figure 116 than in Figure 115. In a thick plate the

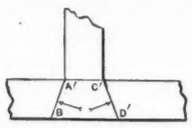


FIGURE 116.

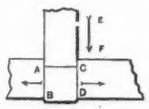


FIGURE 115.

total pressure on AC, and hence the resulting pressure on AB and CD, must be greater than in a thin plate. In a narrow plate the horizontal component of the pressure is readily relieved by the horizontal bulging of the strip as a whole, and the pressure on AB and CD thus lessened. Hence the greater injury in cylindrical than in conical punching, to thick than to thin, and to wide than to narrow plates. For the latter a further reason: as pointed out in § 269, p. 212, the strengthening of the cold-worked part should weigh the more heavily against the weakening due to heterogeneousness of strength, the larger the proportion of the whole sectional area which is cold-worked.

There is general and natural surprise that, in spite of the well-known injury which it does the testing-machine properties punching without reaming or annealing is habitually, successfully, and apparently safely used for both steel and iron boilers and many other important purposes. Not less surprising are Cooper's results, showing how greatly punched holes may be elongated by drifting before the metal cracks. The explanation of this last fact I know not: possibly the first blows on the drift set up a condition closely like that induced by punching, cold-working the ring immediately around the hole, and so quickly remove the initial advantage which the drilled holes had over the punched ones.

Of the apparent practical harmlessness of punching various explanations are offered, none of which seem wholly satisfactory.

The explanation that the structural and boiler plate steel now used is more ductile than that formerly made is beside the point: it will hardly be claimed that it is habitually more ductile than the most ductile steels of Tables 121A and 122, and it is in these that the injury to the testing-machine properties has been abundantly shown. Note the ductility of numbers 8 to 13 and 17 in Table 121. Numbers 8 to 13 in the latter table are from material which when unannealed gave 44·7 % of elongation in 4·5 inches, 61·7 % contraction of area, with 52,475 pound stensile strength and 28,300 pounds elastic limit.

The annealing effect of the heat imparted to the ring around the punched hole by the rivet is a possible but not a satisfactory explanation. In the first place, in the experiments recorded riveting does not seem to benefit thick pieces appreciably, and it is precisely these whose testing-machine properties are most injured by punching and which, therefore, we should expect to be especially treacherous in use. In the second place, we have seen in § 270, p. 214, that gentle heating, say to 300° C. (572° F., a blue oxide-tint), increases or at least accelerates the effects of cold-working, and should, if my explanation is true, still farther raise the elastic limit of the cold-worked ring around the punched hole, the heterogeneousness of elastic limit, and the bad effects of punching: and it may be doubted if any important part of the metal around the punched hole rises above this temperature in riveting. Baker found that the heat imparted by the rivet did not suffice to melt lead, nor even to evaporate water, in some small holes in a plate near the edge of the rivet-hole.[a]

Were we to contend that certain parts of certain plates in our boilers occasionally reach an annealing temperature, the apparent safety of the other plates not exposed to the heat and of punched structures (bridges, ships), etc., which never grow warm, would still confront us. Further explanations, neither of them satisfactory, are the excessive factor of safety (actually of ignorance) used, and that the properties which the metal is actually called on in practice to display are less injured by punching than the testing-machine properties.

Special Forms of Punch.—That the punch may attack the metal gradually, its face, instead of being plane, is sometimes made in steps, is sometimes helical (Kennedy's and others) and sometimes concave-cylindrical, formed by the intersection of a cylinder of large radius with axis perpendicular to that of the punch. Adopted primarily to lessen the stress on the punching machine, these expedients doubtless favor the metal as well. Webb reported the average strength of certain steel plates as 58,579 pounds per square inch when punched with common punches, but as 63,929 pounds when punched with Kennedy's, a difference of eight per cent. in favor of the latter.[b] The step punch, employed for many years in punching steel rails at the Troy Bessemer Works, gave surprisingly good results, but was abandoned years ago in favor of drilling.[c]

Smith's Dynamometer Punch, recording the pressure required in punching, aims to determine quickly and cheaply the hardness of the metal, and thus its fitness for its intended use. It has not come into use.[d]

§ 288A. PRACTICE AS TO PUNCHING.—*A. Structural Work.*—Many of our best bridge-engineers require all punched work to be reamed, say $\frac{1}{16}$ inch all around. Others permit punching without subsequent treatment for riveted work, provided that the punched hole can be increased 25% by drifting, without cracking either the hole or the sheared edge of the plate. But this practice may be regarded as the exception.

The Russian ministry of roads in 1885 forbad both punching and shearing.[e]

At the Forth bridge all work is drilled, and all sheared edges are planed.[f]

I am informed that the best German engineers rarely permit steel for bridges and other important structures to be punched without reaming or annealing, but do not require reaming or annealing in case of punched wrought-iron.[g]

B. *Land-boiler Plates* are generally punched without reaming or annealing. On the Pennsylvania Railroad locomotive boiler-plates less than $\frac{7}{8}$″ thick are thus treated:

[a] Discussion on "The Use and Testing of Open-hearth Steel," etc. Excerpt Proc. Inst. Civ. Eng., XCII., p. 47, 1888.

[b] Journ. Iron and Steel Inst., 1878, I., p. 143.

[c] R. W. Hunt, School of Mines Quarterly, IV., p. 228, 1883, Private Communication, Oct. 1st, 1888.

[d] Trans. Am. Inst. Mining Engineers, IX., pp. 204, 596.

[e] Eng. and Min. Jl., XLII., p. 93, 1886.

[f] B. Baker, Private Communication, Nov. 2d, 1888.

[g] A. Martens, Private Communication, Nov. 1888.

thicker plates are drilled. In England drilling seems to be very much more common than here, in fact to be the rule while here it is the exception.

C. *Marine-boiler Plates*, being much thicker than those of land boilers, are usually drilled, and in the best works are drilled and countersunk in place. The drilling machinery is so excellent that in Britain it is not thought materially more expensive, in view of the greater accuracy of fit, to drill than to punch. Indeed Adamson came to this conclusion soon after 1862.[a] Most American boiler-makers, however, receive this statement with derision. The difference may be due to the more extensive use of gang-drills in Britain than here.

No punching without subsequent reaming or annealing is permitted in case of boilers for the United States navy.[b]

D. *Ship-work* is usually punched. The outer shell-plates are necessarily countersunk, which removes much of the injury due to punching, and some of the best builders ream or anneal the more important members. Yet some ship-builders of the highest standing in Britain and most of those in this country always punch without further treatment (except the countersinking just referred to). In France, too, the mother of drilling, only exceptional pieces are drilled.[c]

For the United States navy steel shell-plates are punched and countersunk: important steel pieces of hull-work are drilled: but many less important steel pieces are punched without subsequent treatment. No wrought-iron plates are used for the hulls, except for monitor-turrets, and these are punched without further treatment. Important wrought-iron pieces (not plates) for the hulls are usually punched without further treatment.[b]

E. Steel rails are always drilled in this country, and, so far as I know, in others

§ 289. Other Forms of Cold-Work.—*Frigo-Tension*, used by bell-hangers to give wire higher elastic limit, consists in subjecting the metal to intermittent stress somewhat above its elastic limit. On the first application the weakest parts stretch; during rest their elastic limit rises; on the next application the next weakest points stretch, gain in elastic limit during the second rest, and so on. The whole piece having been thus affected, on further treatment this succession of effects recurs, raising the elastic limit till it finally coincides with the ultimate tensile strength. Carry the treatment farther and rupture ensues.[d]

When great accuracy of pitch is needed, soft iron chains are treated by this process, being stretched exactly to the pitch sought, and under a stress greater than the expected working stress. The ultimate strength is simultaneously raised.[e]

Cold-hammering acts much like cold-rolling. Steel rods are reduced to wires (*e. g.* Stubs' wire) by rapidly repeated blows of light hammers striking over the whole circumference. The rod is reduced a little, say by $\frac{1}{16}''$ at each operation, and it is said that the whole reduction may be f om $1\frac{1}{4}''$ to $\frac{1}{16}''$.[f] The thin shanks of sewing machine needles are in like manner swaged down from a wire by rapid hammering.

It is said that a given weight of wire yields by this method thrice as many needles as by the old method of reducing the diameter of the thinner part of the needle by grinding.[g] Cold-hammering polishes the metal highly, reduces it accurately and uniformly to the section sought, and doubtless raises its elastic limit.

Hammer-hardening.—According to Overman, surgeons' and engravers' instruments acquire, by hammering with a very small polished hammer, great hardness, a finer edge, and greater elasticity than can be given otherwise.[h] Whether this operation is actually practiced for these purposes I know not: but makers of these instruments whom I have asked have never heard of such a procedure, believe that it would not be effective, and actually harden their instruments in oil after heating to redness in a gas-jet, as I know by observation.

Dean's Process[i] of hardening and strengthening the bore of guns, etc., by forcing through them one or a succession of steel cylinders or olives, each slightly (say 0·05 inches) wider than the preceding, successfully used by him and by Uchatius for bronze guns, is said to be applied now in Belgium to steel gun-tubes, and by the Credenda Steel Tube Company to small steel tubes. It does not, however, appear to diminish erosion in case of steel guns.[j]

BLUE-SHORTNESS.

§ 290. Blue-Shortness.[k]—Not only are wrought-iron and steel much more brittle at a blue heat than in the cold or at redness, but, while they are probably not seriously affected by simple exposure to blueness, even if prolonged, yet if they be worked in this range of temperature they remain extremely brittle after cooling, and may indeed be more brittle then than while at blueness (2 and 3, Table 130): this last point however is not certain..

The loss of ductility as measured by endurance of bending and drifting is enormous: that this is not due to incipient cracks is shown by the simultaneous increase of tensile strength, and by the restoration of ductility by annealing. The effect of blue-working on ductility as measured by elongation (on rupture by static tensile stress) is very irregular, and apparently anomalous: in five out of the eight cases in Table 129 the elongation is greater after than before blue-working. Heating to redness may completely remove the effects of blue-working (4, 5, Table 130).

There is thus a general resemblance between the effects of cold- and those of blue-working, and we may suspect that the immediate effect of these two operations is identical in nature. It is true that the gain in elastic limit does

[a] "Open-Hearth Steel for Boiler Making:" Excerpt Proc. Inst. Civ. Eng., XCII., p. 58, 1888.

[b] Asst. Nav. Constructor R. Gatewood, PrivateCommunication, Nov. 25, 1888.

[c] L'Emploi de l'Acier, Périssé, p. 25, 1884. The foregoing statements about punching-practice are based on extensive inquiries which I have made both here and in Britain.

[d] Thurston, Metallurg. Rev., I., p. 126: Matls of Engineering, III., p. 540.

[e] H. R. Towne, Yale & Towne Mfg. Co., Trans. Am. Soc. Mech. Eng., VIII., p. 180, 1887.

[f] Sweet, Trans. Am. Soc. Mech. Eng., VII., p. 266, 1886.

[g] W. F. Durfee, Idem, Priv. Commun., Feb. 5th, 8th, 1889.

[h] F. Overman, The Manufacture of Steel, p. 61, 1851.

[i] Thurston, Mat'ls of Engineering, III., p. 530; Metallurg. Rev., I., p. 123: Rept. U. S. Commissioners Vienna Exhibition of 1873, III., p. 324: U. S. Patent No. 90,244, May 18, 1869, S. B. Dean.

[j] Maitland, "The Treatment of Gun Steel," Excerpt Proc. Inst. Civ. Eng., LXXXIX., p. 127, 1887.

[k] "The Working of Steel," Stromeyer, Excerpt Proc. Inst. Civ. Eng., LXXXIV., 1886, with a very important discussion. Also U. S. Naval Prof. Papers, No. 21, 1887. A blue heat is here used generically to include straw and blue oxide-tint temperatures, say 220° to 320° C., 430 to 609° F. Brass is said to have a critical temperature of brittleness like that of iron, and some varieties of aluminium bronze appear to have one.

not seem to excel that in tensile strength as markedly in case of blue- as in case of cold-working, nor is it clear that the tensile strength and elastic limit increase during rest after blue- as they do after cold-working. But this is natural: for we saw reason to believe that heating cold-worked iron to blueness greatly accelerated the changes which cold-working starts: so that, when this change is started by distortion at blueness instead of in the cold, it may occur so rapidly and so nearly reach its full growth before the metal grows cold that no considerable further change occurs thereafter. The effects of blue-working are more intense and more injurious than those of cold-working. While the blue-worked iron in tables 128 to 130 is usually somewhat stronger and in one case (very soft steel, 14, Table 129) 8,000 pounds stronger than the corresponding cold-worked iron, the loss of flexibility and drifting power on blue-working is on the whole very much heavier than on similar cold-working. Out of 16 comparable cases in Table 128, the previously blue-worked pieces endures in 1 less than 50% and in 11 less than 25% of the bending endured by the corresponding cold-worked piece.

Adamson,[a] who, after Valton,[b] early called attention to blue-shortness, thinks that it is the more severe the greater the number and aggregate percentage of non-ferrous elements present.[c] No such relation can be traced, however, among the results in tables 128 to 130. Thus the half-hard steel of tables 128 and 129, with 1·17% of non-ferrous elements, cannot be confidently held to suffer more either in flexibility or tensile properties, and whether tested at blueness or after cooling, than the Lowmoor iron with only 0·36% of these elements. Nor is it clear that the wrought-iron, 4 and 5 of Table 129, suffered less than the corresponding steel. Indeed, there is no certainly known connection between composition and blue-shortness.

According to Stromeyer the fracture at blueness is silky, though the steel is fairly rotten: but blue-worked pieces broken cold yield a crystalline fracture.

TABLE 128.—EFFECT OF PREVIOUS COLD AND BLUE-HEAT TREATMENT ON FLEXIBILITY (ENDURANCE OF REPEATED BENDING). STROMEYER.

The bendings of last four columns for line 2 were done at blueness, all others were done in the cold.

	Preliminary treatment.	Number of 40° bendings (after preliminary treatment) endured before rupture. I. Lowmoor iron C = 0·02 %.	II. Very soft steel C = 0·05 %.	III. Soft steel C = 0·16 %.	IV. Half-hard steel C = 0·29 %.
1	Unprepared	21	27	6	15
2	Unprepared	3 @ 7 blue.	2·5 @ 7 blue.	1·5 blue.	2·5 blue.
3	Annealed at blueness	14 @ 19	18 @ 27	7 @ 9	3 @ 5
4	Quenched at bl eness	17	10 @ 11	6 @ 10	1
5	Annealed at redness	19	25	12·5	21
6	Annealed at redness, then at blueness			7	22·5
7	Quenched at redness	29	19a @ 33	10a	1 @ 24
8	Quenched at redness, then at blueness			9 @ 12·25	17 @ 26
9	Hammered cold	9	21		
10	Hammered at blueness	6 @ 7	0		
11	Quenched from redness, twisted cold b	23	15	11a	22a
12	Quenched from blueness. twisted cold b	15	18	11a	0·5a
13	Twisted blue b	7	1	9	21

	Preliminary treatment.	Length of rest, days, between preliminary treatment and bending. 1	7	35	1	7	35	1	7	35	1	7	35
		Number of 40° bendings endured before rupture.											
14	Bent cold once; then rest							10	9		20	20	
15	Bent cold twice; then rest							9	9	4·5	18·5	21	20
16	Bent once at blueness; then rest	10 @ 16			6 @ 14			1	4	1·5	5·5	2	1·5
17	Bent twice at blueness; then rest	6 @ 12·5			0 @ 2			0	0	0	1	0	1

a Annealed instead of being quenched.

b In lines 11 to 13 the preliminary treatment for Lowmoor iron and very soft steel was to twist the piece 90° four times in a length of 6 inches, apparently 90° and back twice. In case of soft and half-hard steel it was to twist the piece 45° in a length of 6 inches, one way and back. Each piece of the half-hard and of the soft steel was first baked for two nights in a moulders' core-oven. The bendings of the last four columns were each of about 40° to a radius of 1·75 inches, the piece being bent 40°, straightened, bent 40° in the opposite direction, and so forth. "Blueness" is used generically to include straw and blue oxide-tint temperatures, or say 230° to 316° C. (446° to 600° F).

In every case except line 2 the numbers in columns I. to IV. are the numbers of bendings in the cold through 40° which the piece, after receiving the treatment specified in the column "preliminary treatment," endured before rupture. In line 2 the numbers indicate the number of 40° bendings at blueness which the piece without previous treatment endured at a blue heat before rupture.

TABLE 130.—EFFECT OF BLUE AND COLD WORK ON DUCTILITY AS INFERRED FROM DRIFTING. STROUDLEY.

	Treatment before drifting test.	Drifting temperature.	Endurance of drifting. Diameter, inches, at rupture.
1.	Unprepared	Cold.	1·94@2·06.
2.	"	Blue.	1·90.
3.	Drifted at blueness to 1 5″, then: Cooled slowly	Cold.	1·52@1·81.
4.	Drifted at blueness to 1 5″, then: Heated to redness and quenched	Cold.	2·5.
5.	Drifted at blueness to 1 5″, then: " " and cooled slowly	Cold.	2.09@2·5.

Pieces of open-hearth steel frame-plate 1″ thick, cut in a planer to about 8″ square, had a hole 1″ in diameter drilled with its centre 1·75″ from each edge. These holes were then treated as indicated, and then drifted with drifts having a taper of 5 per 100 of length, till they split. In certain cases the rupture-crack was from 0·05 to 0·12 inches open. (Discussion of Stromeyer's Paper, p. 65.) In each case the test-piece first underwent the treatment given in the second column: was then drifted at the temperature indicated in the third column, till it split, when the hole had been drifted out to the diameter indicated in the third column.

a Journ. Iron and St. Inst., 1878, II., p. 396.

b Valton, Metallurg. Rev., I., p. 170, October, 1877.

c Jour. Iron and Steel Inst., 1887, I., p. 9. T. Gillott, Jeremiah Head and Isherwood state that steel is injured more than wrought-iron by blue-working. Others hold the opposite view. "The Working of Steel," Stromeyer, pp. 89, 57, 86, 67.

TABLE 129.—EFFECT OF COLD AND BLUE-HEAT TREATMENT ON TENSILE PROPERTIES (STROMEYER).

	Preliminary treatment.	Wrought-iron. I. Tensile strength, lbs. per sq. in.	Elastic lim., lbs. per sq. in.	Elongation.	Very soft steel. II. Tensile strength, lbs. per sq. in.	Elastic lim., lbs. per sq. in.	Elongation.	Tensile strength, lbs. per sq. in.	Elastic lim., lbs. per sq. in.	Elongation.	Tensile strength, lbs. per sq. in.	Elastic lim., lbs. per sq. in.	Elongation.
1	Annealed				66,528	43.232	20·1						
2	Flattened cold				71,680	45,920	12·9						
3	" blue				81,312	56,000	9 5						
4	Unprepared	50,624		20·5 @ 24	64,512		23						
5	Tested blue	67,424		10 @ 16·5	80,192		15 2						
6	Unprepared				68,320		44 ?						
7	Bent cold				73,920		9						
8	" blue				72,128		3						

		Lowmoor wrought-iron. III C = 0·02 %.			Very soft steel. IV. C = 0·05 %.			Soft steel. V. C = 0·16 %.			Half-hard steel. VI. C = 0·29 %.		
9	Unprepared	49,600	28,000	6·7	61,000	40,992	24·8	59,400	36,064	34·7	72,900	43,904	11·5
10	Blue-annealed	49,900	31,584	14 2	60,500	45,024	10·4 @ 20·6						
11	Bent cold	52,100	31,584	18 8	63,000	41,449	18·0	65,000	34,944	24·3	71,000	40,992	7 2
12	" blue	52,900	28,000	7 1	66,000	51,072	29·4	67,000	40,992	20·2	76,000	43,904	16·7
13	Twisted cold	52,000	34,048	8 5	63,100	38,080	16·3	66,100		16·8			
14	" blue	55,000	36,512	16·3	71,000	55,104	27 9	67,900	47,488	22·4			

In every case, except line 5, the numbers in columns I. to VI. are the results of tests in the cold made on test-pieces which had endured the treatment specified in the column "preliminary treatment."

In line 5 the previously untreated piece was ruptured tensilely at a blue heat

The treatment is supposed to be identical for the several columns of each line, except for those of line 9.

The lines braced together are supposed to represent tests of the same material or materials.

All tests were made cold except Number 5, which was tested while blue-hot.

2 and **3**, flattened cold on a smith's anvil, and thus thinned apparently by 1·5%.

7 and **8**. W. Stroudley, discussion of Stromeyer's paper, p. 64. They were bent once 45°, and straightened by hammering.

9 to **14**. The ***unprepared*** (9) soft and half-hard steel had been annealed from redness.

The ***blue-annealed*** (10) pieces were kept at blueness during four nights.

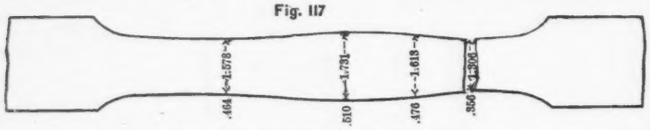
The ***bent*** pieces (11, 12) were bent to a radius of 15″ and flattened: I think this means that they were bent double, and the bend flattened close, and not reopened: but the wording is obscure.

The ***twisting*** (13, 14) was through an angle of 90° and back, in 12″.

Stromeyer, The Working of Steel, excerpt Proc. Inst., Civ. Eng., LXXXIV., 1886.

The strengthening effect of blue-working is well illustrated by bending a common tensile test-piece in the middle while blue-hot, straightening, cooling and pulling it, when it breaks as in Figure 117, the unstrengthened ends contracting and yielding.[a] Extreme blue-shortness is

Fig. 117



Local Strengthening by Blue-working. Unwin.

reported in the case of a soft-steel gun-coil,[b] which, cooled to blueness owing to delay at the hammer, shattered when struck: and in that of a steel plate[c] which, though very malleable at whiteness and when cold, went to pieces while rolling, as it cooled to below redness.

Valton found that his workmen had long recognized blue-shortness, and avoided hammering at blueness: it is said to have been known in the Yorkshire iron works for more than fifty years, and some steel-makers[d] have long urged their customers to avoid blue-work: yet the discussion on Stromeyer's paper in 1886 showed that many experienced iron-workers then disbelieved in or were ignorant of blue-shortness, and I have found this true of very many American iron-workers.

But while blue-working even in moderation certainly lessens ductility, at least in the great majority of cases, yet the injury is not necessarily fatal. Thus Stromeyer found that two twists of 45° in a length of six inches did not diminish the bending-endurance of very soft steel and Lowmoor iron materially, though four twists of 90° injured them greatly (13, Table 128). Steel plates $\frac{1}{16}$″ thick have been bent to a nearly closed circle 19″ in diameter, flattened again, and again bent the reverse way to the same circle, all at blueness, without sign of rupture.[e]

Two plates, one heated to blueness, the other forged while its temperature fell from bright redness to blueness, were bent double, flattened under a steam-hammer, and again broken open while blue-hot: no crack could be detected at the outside of the bend.[f] Their fractures exactly resembled those of a similar piece bent double and opened similarly but cold. Again, though many recognize that machine-riveting has a great advantage over hand-riveting, in that its work ceases before the rivet cools to blueness, while the hand-riveter usually continues hammering while the rivet is passing blueness[g]: yet relatively few hand-worked rivets fail in use, and the difficulty in getting riveted work apart does not point to serious injury. Millions of car axles, blue from "hot boxes," are chilled with snow and jarred under heavy load at loose rail-joints, yet are apparently unharmed. Among the many thousand steel boilers, tens of thousands of plates must have been worked more or less at blueness: yet failures are rare. Finally, much crucible steel, in the form of bars, plates, etc., is habitually rolled or hammered till its temperature has fallen below visible redness. The lesson thus seems to be, avoid blue-working wholly if you can: if not, then use it cautiously and very moderately, unless you anneal later.

By heating in their bearings marine and other shafts, railway axles, etc., are liable to reach blueness, as are guns through rapid firing, when accidents may readily occur. In practice many of the best American bridge engineers do, others do not positively forbid blue-working. The Russian Ministry of Roads in 1885 ordered that all bending should be hot, apparently at redness.[h]

Blue-working without subsequent annealing is rarely permitted for the steel of the Forth Bridge, though the rivets and small angles and tees are liable to be worked to blueness, and are not subsequently annealed.[i] I am informed that good German bridge engineers permit blue-working occasionally in case of steel, and usually in case of wrought-iron.

It is said that some boiler-makers allow no blue-working, stopping work when the metal becomes so cool that it no longer glows when rubbed with wood: others stop while the metal is still visibly red. Others insist that it is necessary to adjust some work, *e. g.*, marine boiler-fronts, at blueness: that, despite the most careful hot-working, adjustment is needed after the distortion due to cooling, especially as, owing to the endless variety of patterns, flanging in the press at a single heat is not practicable: that adjusting cold would lead to excessive waste of time, as iron is bent more quickly at blueness than when cold: hence these pieces are warmed locally to blueness by applying hot irons. To anneal afterwards would be useless, as fresh adjustment would be needed after cooling. Certain it is that most American, and at least many foreign boiler-makers, habitually adjust at blueness. Blue-working without subsequent annealing is forbidden for boilers for the United States navy, but not for the hull-work.[j]

THE TREACHERY OF STEEL.

§ 291. The Treachery of Steel.—We may arbitrarily divide the failures in steel and wrought-iron into the normal ones which occur because the known proper conditions of manufacture or use are violated, and the really mysterious ones. Of course, many failures placed in the first class might on further examination be found to belong to the second.

The evidence seems to show that of a given number of pieces, say 100,000 of wrought- and 100,000 of ingot-iron, more of the former than of the latter fail in manufacture, assembling and use: ingot-iron is on the whole more trustworthy than puddled iron. But though the failures are fewer among the 100,000 ingot-iron pieces, yet the number of mysterious, *i. e.*, as yet wholly inexplicable failures, is greater among them than among the wrought-iron pieces. To this evidence I will return.

In the early use of Bessemer and open-hearth steel many then unexplained and hence then mysterious failures occurred. With our present knowledge an easy ex-

[a] This result is reported by three observers independently, Unwin, B. Baker and F. W. Webb, (op. cit. pp. 44, 54, 96).

[b] Bramwell and [c] Bessemer, op. cit., pp. 83, 87.

[d] *E. g.*, the Steel Company of Scotland.

[e] W. Parker, [f] W. Anderson, Idem, pp. 39, 61, 41. I use Mr. Anderson's words, as I am not quite certain of their meaning.

[g] In riveting ships' plates the rivet is usually left while hot, and again tightened up when cold, while in boiler-riveting the rivet is worked continuously, and, of course, through the blue heat. This is because the flat counter-sunk head of the former is quickly finished, so that, if it is to be tightened cold, a considerable interruption naturally occurs at blueness: while so much more work is needed in making the conical head of the boiler-rivet that, though worked continuously, it grows nearly cold before it is finished.

[h] Eng. and Mining Jl., XLII., p. 93, 1886.

[i] Private communication, B. Baker, Nov. 2d, 1888.

[j] R. Gatewood, private communication, Nov. 25th, 1888.

planation of most of them would probably have been seen. But even to-day certain unexplained and apparently inexplicable failures occur in steel, inexplicable in spite of full and intelligent investigation. They are extremely rare, but I do not think that they can be ignored or ridiculed. The mystery in some of them may be due to overlooking or purposely suppressing conditions which would readily explain them: but I believe that the true explanation of others lies beyond our present knowledge.

I learn of a few truly mysterious accidents to wrought-iron: they have not attained the publicity that has befallen the mysterious failures of steel, thanks partly to many motives, mostly honorable, and partly to the very nature of the case: the newer metal, on probation, has deserved the closer scrutiny.

But the mysterious accidents reported in case of steel exceed those in case of wrought-iron to a greater extent than can be readily accounted for in this way. One additional explanation is that, owing to the very nature of the processes by which steel and wrought-iron are made, carelessness and ignorance, whether in selecting materials, in conducting the processes, or examining the product, is more likely to lead to the making and selling of treacherous steel, treacherous simply because unsuited to the purpose for which it is sold, *i. e.*, too highly carburetted; or positively bad, bad owing to a combination of high phosphorus with high carbon, to serious segregation, to serious pipes, internal cracks, etc. The very pliancy of the steel-making processes, the ease for instance with which the carbon-content of a Bessemer or an open-hearth charge may be raised at the shortest notice from 0·05 to 1%, demands increased watchfulness to prevent and detect unsought variation: invaluable to the watchful and the intelligent, it is a stumbling block to the ignorant and the heedless.

Further, it is conceivable that the presence of slag in wrought-iron, while a source of weakness, may in some obscure way lend a certain security against the mysterious failures whose very nature is obscure.

Let the mysterious class of failures be illustrated by two famous cases, one in which steel plates, which had passed an examination, seemed to become extremely brittle after rolling and testing but before the boilers made from them were tested, a case which caused widespread dismay; and another in which steel, certainly initially good enough to endure the trying conditions of boiler-construction, became astonishingly brittle during two and a half years' service.

§ 292. Two Mysterious Cases.—*The Lividia Case.*[a] Some $\frac{3}{4}$-inch steel boiler-plates, containing about 0·15% of carbon, rolled from 22-inch ingots, had passed tensile, and quenching and bending tests well (nearly all the latter being satisfactorily passed by rough sheared unplaned pieces), had been punched, heated slightly, and bent to the proper curvature, and the rivet holes had been reamed out about $\frac{1}{16}$-inch to size in place, when an accidental concussion caused the steel to crack between some rivet holes not in the immediate neighborhood of the spot directly injured. The plates, thought to be injured by punching, were now annealed, but in such a way that some of them may have been much overheated. The boilers were now riveted apparently safely: but one tore asunder in three pieces in hydraulic testing, before reaching 140 pounds pressure, while another was found cracked behind the rivet holes before the testing water was introduced. The metal was now carefully studied. Large pieces could be broken from the plates with a single blow of a hammer: the metal still showed normal tensile strength and elongation, but an abnormal fracture, in part with brilliant facets from one eighth to one quarter-inch wide. Under bending tests, strips cut close to the rivet-holes and others purposely punched were extraordinarily brittle, while others cut at a distance from the rivet-holes behaved normally. Strips containing the original rivet-holes became tough on annealing: others purposely punched were made tough by either reaming or annealing. Examination of one plate showed marked but not extraordinary segregation (No. 62, Table 96). When the plates were rolled to $\frac{3}{8}$, or half the original thickness, the fracture and properties in general became normal.

I offer the following explanation: it may not be the true one, but it seems to cover the ground. The plates were bad initially, possibly owing to excessively high casting temperature. Witness the undue brittleness caused by punching and the segregation: but not so bad that they could not pass a somewhat perfunctory examination. If properly annealed they would probably never have been heard from. In annealing they were burnt: witness the brilliant ultra-coarse fracture. The burning was naturally most severe along the edges which would be the hottest part: hence the much greater brittleness near the punched holes than away from them. The burnt steel was naturally made extremely brittle by punching.

The effects of burning were modified to a certain extent by annealing, but not completely removed. The brittleness directly due to burning was greatly lessened: hence the annealed strips bend fairly. But the tendency to become brittle when punched is not removed, or not removed so completely: hence the metal, even when annealed, is again made brittle by punching. But while the annealing applied *before* punching does not remove this liability to be made brittle by punching, applied *after* punching it removes the effect of this operation: hence the fair bends obtained with the metal annealed after punching. Remember, all this is hypothesis: we do not know that the effects of burning persist in this specific way.

The Maginnis Case.[b]—Each of two British steamers, 1 and 2, in the transatlantic and colonial trades, had three boilers built by Jack, from steel made by the Weardale Coal and Iron Company, in two-and-a-half-ton acid Bessemer converters, cast in ingots about nine inches thick, and reduced to plates from ·41 to ·74 inch thick, and containing (at least in case of some cracked combustion chamber plates):

Carbon,	Silicon,	Manganese,	Phosphorus,	Sulphur,
·12@·17	·005@·018	·32@·58	·06@·068	·043@·051%

The tensile properties follow.

	Tensile strength, pounds per sq in.		Elongation, in 10″.
40 tests before leaving the works	58,332@68,095		19·75@27
Tests from cracked combustion chamber plates, steamer 1, 4 tests, fractures fine-crystalline	from 104,026 and 106,400 to 90,720	with " "	15 7·75 13
Do. do., steamer 2, 7 tests, fractures "fibrous, silky, fine"	from 54,298 and 56,851 to 60,122	" " "	24·5 8 26

The steel actually used passed an inspection by Lloyds'

[a] W. Parker, Chief Eng., Surveyor to Lloyd's Register, Trans. Inst. Nav. Arch. XXII., p. 12, 1881.

[b] A. Maginnis, "The Engineer," LX., p. 447, 1885. Also W. Kent, Trans. Am. Inst. Min. Eng., XIV., p. 812, 1886.

and the Board of Trade, but forty per cent of that supplied failed to pass, and was replaced. The accepted material endured the usual boiler-shop work, welding included, without mishap. The furnaces were annealed after welding.

With careful scaling and the usual precautions, the boilers behaved normally in service for two-and-a-half years, when they failed in the following remarkable way.

Steamer 1.—Three weeks after blowing down, and while no work beyond the usual scaling was going on, a crack about thirty inches long, open one-eighth inch at bottom and one-sixteenth at top,[a] formed spontaneously in a combustion-chamber plate. About three months later, and a few days after shutting off steam, a circumferential crack over two feet long formed with an alarming report, in a wing furnace from which workmen were removing the scale.

Steamer 2.—At the same period of work as in case of steamer 1, and thirteen days after letting down steam, a crack twenty-seven inches long formed in a combustion-chamber plate with a report which nearly deafened even a boiler-maker. Three months later a further crack formed.

Parts of the plates now being extraordinarily brittle, the boilers were broken up, with startling results. In unriveting the pipes connecting boiler and steam chest, after a few blows they were found cracking in all directions, so much so that none of the nine of steamer 2 came off whole. Next a butt-strap cracked almost across between rivet-holes. Later "a general smash was experienced, the front-plates cracking and starring, and the flanges breaking off. The furnaces at the same time acted in just the same manner, the cracks going through the rivet-holes to such an extent as to allow the ends to come off whole, and so form hoops for the lads to play with in the meal-hour."

I see no easy explanation. Internal strains and deterioration, homogeneousness, crystallization, excessive dimensions of plates, and untrustworthiness of Bessemer steel in general, are justly pointed out by Kent to be improbable causes: innumerable plates appear to be subjected to conditions favoring failure from these causes as much as these plates were. Yet they do not fail, while not one or two, but very many of these plates fail astonishingly. His own explanation, heterogeneousness, owing to imperfectly mixing the recarburizer with the blown metal, hoists with his own petard, because we know that plates, rails, etc., are often if not usually markedly heterogeneous, yet they fail not. Neither is it probable that a degree of heterogeneousness sufficiently unusual to induce such unusual results would have happened to fall on all these plates, representing many different Bessemer blows, especially as good boiler-plate steel had been made for years in these same converters, and, according to the steel-maker, under exactly the same conditions, with one exception—that these plates were thicker than those previously made. Herein lies a possible explanation. Clearly, if the temperature to which the ingot is raised for rolling, the rapidity of rolling, and the reduction per pass be the same, the metal's temperature will be much higher if rolled to a thick than if farther reduced to a thin plate: so that these thick plates, made from thin ingots, may have left the rolls at so high a temperature that serious crystallization occurred during the subsequent slow undisturbed cooling. But this is not wholly satisfying, first, because other pieces of steel, and notably rails, are often finished unduly hot without disaster: and, second, because, so far as I know, an unduly high finishing temperature does not produce this specific effect of yielding a metal which, only moderately bad at first, undergoes extraordinary deterioration under the indefinitely repeated expansion and contraction, vibration, etc., incident to use. This objection, indeed, applies with equal force to all other theories but one, to wit, that the boiler underwent some extraordinary treatment during service, such as being highly heated and then quenched with water. But it is improbable that this would happen to all six of these sister-boilers in two different vessels at the same period of service.

Careless inspection, permitting some plates or heats to pass untested, might account for the difference between the original tensile properties and those found in strips cut from the broken pieces, but not for the extraordinary brittleness after service of plates which before service must all have been at least moderately tough, for they endured the trying ordeal of boiler-making. We can hardly doubt that the metal deteriorated greatly after the boilers were made, though the tendency or liability to deterioration was probably incurred in the steel works or the boiler-shop, or in both: but how incurred we know not.

One striking feature must not be overlooked: the failures occurred when the boilers were not under steam. This may give the future investigator a clue. I am informed that, on the Pennsylvania Railroad, there have been within the last ten years perhaps twenty cases in which the boiler-plates of locomotive engines have snapped when either cold or under half steam. My informant is not sure that a single such case has happened under full steam.[b]

§ 293. CASES THOUGHT TO BE NORMAL, AND OTHERS.—Of the other class of failures which I have termed normal, those which are supposed due to violation of known canons of manufacture or treatment, we find a large part attributed to blue-working:[c] internal stress due to local heating, and heterogeneousness of strength and of elastic limit due to cold-working come in for their share also. In 1881 Parker reported that, in the construction of 1,100 steel boilers, representing 17,000 tons of material, none of Lloyd's surveyors had met a single brittle plate. They had investigated many of the supposed mysterious failures of steel plates which had stood all the required tests, had been riveted into place, and then had been reported to crack without being touched; and they had traced them all clearly to improper manipulation, the metal in the neighborhoood of the crack being found ductile as soon as rupture had relieved the internal stress.[d] He gives the following as an example: A 10-foot boiler was nearly completely riveted, when, on returning from dinner, the

[a] These numbers are as given by Maginnis. Others have quoted him incorrectly.

[b] Dr. C. B. Dudley, private communication, Nov. 26, 1888.

[c] J. Riley states that in every or nearly every case of mysterious failure of ingot iron that has come before us (the steel makers) we have concluded that it was due to working at blueness. Trans. Inst. Nav. Arch., XXVII., p. 131, 1886.

[d] Trans. Inst. Nav. Arch., XXII., p. 12, 1881.

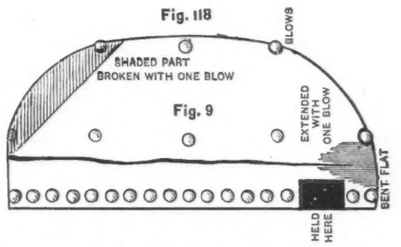
(TO BE CONTINUED.)

riveters found that the plate which they had lately been working had torn for a distance of eighteen inches. By accident the bolts that had been holding the furnace up to the front-plate had not been taken out. On removing them, the rivet-holes, though originally drilled true in place, were found quite $\frac{1}{8}$th inch blind, showing that the furnace had been smaller than the circular part of the plate to which it had to be riveted, had been stretched in riveting, stress being thrown on the metal which eventually sufficed to tear it.[a]

It is surprising that the workmen could put enough stress upon the plate to tear it at all, were it free from initial flaw or weakness: further, as the flue was nine feet in circumference, and as the metal shows 26% elongation in tensile testing, uniform strength should enlarge the flue by more than two feet before causing rupture, while only $\frac{1}{8}$ of an inch displacement or 0·12% is actually proved.[b] Thus this explanation is not exactly convincing on its face: yet it may be the true one: for we have seen in § 269 and especially at the end of § 271, B, p. 217, that the total elongation may be greatly lessened by cold-working, and that the effects of cold-working go on increasing long after the cold-working itself has ceased: and so may the capacity for elongation have been here greatly lessened by the peculiar, oft-interrupted, jerky stretching which the material underwent as it was drifted and stretched. Further, it is possible that the stretching, far from being uniformly distributed, may really have been gradually concentrated by successive rivets, so that a continually and at last rapidly increasing proportion fell on successive parts of the plate. Thus we should not scout Mr. Parker's statement,—he voices the opinions of many intelligent engineers—yet it seems to me probable that many failures which are referred to brutal treatment from the boiler-maker may be due to other causes, such as a line of brittlenes in an otherwise tough plate, and that a considerable proportion of the failures is still imperfectly explained. We instinctively seek explanations, and, failing a satisfactory one, gull ourselves, and hatch our porcelain nest-eggs.

Many of these surprising cracks in ingot-iron plates occur without reduction of the metal's area at the cracked edge,[c] while under common tensile stress the area would usually be reduced by more than 40 and sometimes by more than 60 per cent. In some of these cases the metal at the very edge of the crack seems tough. Again, sometimes the cracks can be readily extended, or even extend themselves, for a certain distance, while beyond they obstinately refuse to go. Here are a few examples.

In the Maginnis case, some cracks which were started by hammering began by showing a peculiar black shade about half an inch wide, and after another blow a faint hair-like score became visible, which without further blows gradually opened and extended automatically, till fully developed: other cracks formed almost simultaneously with the blow of the hammer. In two cases Maginnis had the metal on one side of the crack held firmly, while that on the other was struck in order to extend the crack, as shown in Figure 118. In one, the crack extended about four inches at the first blow, leaving only 2·5 inches of solid plate. The remaining part was hammered flat and re-straightened without extending the crack. The other was hammered flat in the line of the c ack, straightened, and hammered flat in the opposite way without lengthening the crack.



Spontaneous Cracks which cannot be Extended. Maginnis.

In another case a crack with bright crystallized sides, in an open-hearth steel plate, could not be extended by wedging, apparently having gone its full length automatically, and then refusing to go further. Tensile and bending tests from its very sides were normal.[e]

In removing a long-used steel locomotive fire-box to repair its cracked crown sheet, two opposite side sheets cracked, one of which, containing 0·17% of carbon, was examined at the Watertown arsenal.[d] The crack extended into five stay-bolt holes, stopping 3·5 inches short of the sheet's edge, and was formed with no apparent contraction of the plate's sectional area: its surfaces were granular with a marked radiant appearance. Yet the metal was fairly ductile around and even at the very edge of the crack: for a strip, cut parallel with and including one edge of the crack, was bent 180° and nearly closed down without rupture, and tensile test-pieces cut from near the crack had the following properties:

	Tensile strength lbs. per sq. in.		Elastic limit, lbs per sq. in.		Elongation, % in 10″.		Contraction of area %.
From.....	64,000	with	44,530		15·2	and	43·4
To.....	65,910	"	44,240		19·5	"	51·7

C. L. Houston[e] reports that a $\frac{5}{8}$-inch steel plate was flanged into a locomotive throat-sheet: the next morning a crack appeared at the opposite, unheated, untreated, planed end, and grew for about a week, finally reaching across the plate to the part which had been heated. The tensile strength of a test-piece which had the crystalline face of the crack for one edge was 68,580 pounds per square inch, its reduction of area 42%, and its fracture fibrous.

The stress induced by sudden cooling is doubtless the cause of the treachery of hardened steel, of which a case has been noted in a foot-note on page 181, and which is further illustrated by the failure of some steel punches and dies which, after hardening without tempering, were ground 0·001 inch five times alternately on each side, reducing their total thickness by 0·01 inch. A few hours after grinding they began to crack and nearly all were thus ruined.[f] Grinding still more lightly, so that only 0·001 inch was removed in ten grindings (approximately of 0·0001 inch each), the same results followed.[g]

But sudden cooling cannot account for these accidents

[a] W. Parker, discussion of Stromeyer's paper on the Working of Steel, Excerpt. Proc. Inst. Civ. Eng., LXXXIV., p. 35, 1886.
[b] Cf. Unwin, Idem, p. 43
[c] A. C. Kirk, Trans. Inst. Nav. Arch., XXVI., p. 263, 1885.
[d] Rept. Tests of Metals at Watertown Arsenal, year 1885, p. 1,053, 1888. This interesting case is here admirably illustrated.
[e] Trans. Am. Soc. Mech. Eng., X., 1889, to appear.
[f] L. K. Fuller, Trans. Am. Soc. Mech. Eng., X., 1889, to appear.
[g] Idem, Private Communication, Dec. 12th, 1888. I have one of these interesting dies in my collection.

to boiler-plate steel, for the metal itself is tough as soon as the stress has been relieved by cracking.

The cause of such cracks as these is certainly obscure. They may be due to defects in the ingot, such as a pipe, or heterogeneousness due to segregation or to imperfect mixing. If to a pipe, it is not easy to see why its sides are not welded at least so well that a certain amount of reduction of area occurs on rupture. They may be due to the splitting apart of the coarse crystals which form at a high temperature: but if so it is surprising that these crystals are not broken up during rolling. They may be due to an unduly high finishing temperature: but if so, why does the crack stop so abruptly? They may be due to severe highly localized stress, due in turn to local heating. Such stress combined with unduly high finishing temperature and with heterogeneousness, seems a possible cause. In the first place the very rarity of such failures suggests that they are due, not to a single condition, but to an unusual combination of conditions. Next, heterogeneousness and high finishing temperature help to account for the brilliant coarse crystallization. Heterogeneousness helps to account for the fact that, when these failures occur at all, it is usually in bad steel; because bad steel, whether bad because cast too hot, because too phosphoric, or because so cold that the recarburizer does not melt and diffuse thoroughly, is especially liable to heterogeneousness, high casting temperature clearly favoring segregation, high phosphorus favoring the segregation of phosphoric, brittle, coarsely crystalline bodies. Heterogeneousness and local heating help to account for the extreme localization of the weakness. Suppose a thin streak of some segregated, say phosphoric compound, or of an unmelted lump of recarburizer, existing in the plate: suppose that this compound tends strongly to crystallize coarsely: suppose that, thanks to this and to its different rate of dilatation, our line of weakness is intensified during heating and cooling: that a high finishing temperature further favors coarse crystallization: that, during the cooling which follows some local heating, and while the temperature is sinking past some point of critical weakness, say a blue-heat, irregular contraction induces a stress perpendicular to our streak, sufficient to weaken the adhesion between the dissimilar coarse crystals which constitute it, perhaps sufficient even to part some of them, or at least to break off the dowels which bind them together. The weakness of our streak is now greatly exaggerated, and a relatively slight stress arising in service may suffice to cause rupture. Now if we lacked heterogeneousness, or if the stress due to local heating had such a direction and intensity that it just failed to part our crystals at blueness, or if our segregated body had not been made coarsely crystalline by high finishing temperature, our weak streak might still be but little weaker than the rest of the metal: for while a stress which just fell short of causing incipient rupture at a temperature of critical weakness might do little harm, a slightly greater stress might be disastrous.

The above is not offered as the true explanation: indeed, it seems to me forced: but merely as an example of the kind of rare combination of circumstances which may lead to mysterious failure.

Here are a few other cases.

1. In testing a cylindrical steel boiler 13 feet in diameter, properly designed for 150 pounds pressure, when the pressure reached 240 pounds a plate 1¼ inches thick, weighing nearly three tons, tore completely across. The tensile strength of a strip from this plate was 66,304 pounds per square inch, and its elongation 20% in 8 inches: other strips bent nearly double cold, yet the plate now failed under less than a quarter of this stress, and without appreciable elongation or reduction of area. Its failure is attributed to its high proportion of carbon, about 0·30%, unfitting it for the rough treatment of the boiler-shop: and to its thickness, which probably led to finishing at an unduly high temperature and to unduly slow cooling, both leading to coarse crystallization. Admitting these, the low ductility and tensile strength of material which had behaved so well under test is still surprising.[a]

2. A ship's steel stringer plate, worked into place satisfactorily, cracked during the next night not through the rivet-holes or any point of weakness, but through its solid body.[b]

§ 294. The Trustworthiness of Steel, both absolute and relative to that of wrought-iron is here evidenced.

First, we have the simple statements of eminent engineers, such as B. Baker,[c] who has had more cases of mysterious fracture with the few tons of wrought-iron than with the 24,000 tons of steel used at the Forth Bridge, where the work is pressed forward night and day with no precautions which would not be needed equally in case the best Lowmoor wrought-iron were used: Sir E. J. Reed,[d] who states that officers and men in the Admiralty dockyards are perfectly enamored of steel, finding it much more trustworthy in every way than wrought-iron: and A. C. Kirk,[e] who, far from having to treat steel more carefully than wrought-iron, habitually and successfully subjects it to treatment which would be fatal to wrought iron.

Then we have such remarkable numerical results as the following. Adamson[f] has lost but one plate among 3,500 received from a certain steel-maker: in welding 600 to 700 feet of steel plates weekly he loses perhaps one plate or so in three months, while with wrought-iron the failures amounted to 12·5%: and not an accident has happened to any of the 3,000 steel boilers which he has built.

Krupp,[g] whose guns are of crucible steel, states that not a single gun made by him during the last seventeen years has burst.

J. Ward[h] of the famous shipbuilding firm of Wm. Denny

[a] W. Parker, "Experience in the Use of Thick Steel Boiler-Plates." Excerpt Proc. Inst. Nav. Arch., XXVI., 1886.

[b] Sir E. J. Reed, discussion of Stromeyer's paper on "The Working of Steel." Excerpt Proc. Inst. Civ. Eng., LXXXIV., p. 73, 1886: Also U. S. Naval Prof. Papers, No. 21, p. 64, 1887.

[c] Engineer in charge of the construction of the Forth Bridge. Trans. Am. Soc Mech. Eng., VIII., p. 168, 1887. It is but fair to state, however, that Mr. Baker permits no punching, requires all sheared edges to be planed, and rarely permits blue-working. (§ 288, A, § 290.) These precautions are doubtless desirable even in case of the best Lowmoor iron, but opinions may differ as to their being necessary.

[d] Discussion on Stromeyer's paper on Mild Steel the Working of Steel. Excerpt Proc. Inst. Civ. Eng., LXXXIV., p. 73, 1886.

[e] Of the great ship-building firm of R. Napier & Sons, Glasgow. Trans. Inst Nav. Arch., XXVII., p. 124, 1886. "With steel, we go round a heavy flang eleven inches deep, as I have done often enough, knocking it down with a steam hammer. I have not had a case of failure. If it had been a piece of (wrought-iron plate I dare not have done such a thing at all, the first blow would have broken it right through. Again, to flange a steel plate for a furnace mouth we push a die right through at one heat which we dare not do in iron."

[f] Discussion on Goodall's paper on "Open-Hearth Steel for Boiler-Making," excerpt, Proc. Inst. Civ. Eng., XCII., p. 63, 1888.

[g] Stahl und Eisen, VIII., p. 52, 1888.

[h] Trans. Inst. Nav. Arch., XXVII., p. 65, 1886.

and Brothers, (which goes on the principle that if steel cannot stand the rough usage of shipyard in punching, shearing and hammering, the sooner it fails the better), in building eighty steel vessels used, up to the year 1880, 7,000 tons or 58,000 pieces of steel, losing six plates and one angle-piece, or about 0·01%; and from 1880 to 1886 48,000 tons of steel or 350,000 pieces, losing 12 pieces, or 0·003%. They have often lost more than four times this amount in a single wrought-iron vessel.

B. Martell,[a] Chief Surveyor of Lloyd's Register, reports that up to and including the year 1885, 444 steel vessels were built, and classed by his company. Among these he learns of seven total losses, which he thinks remarkably few: one was by stranding, two vessels foundered in gales, one was sunk by an iceberg, one by a sailing vessel, two were lost by means not stated. In an investigation by Lloyds' surveyors into the durability of steel vessels, sixty cases were specially reported on: in five out of the eight typical cases which Martell reports, the steel vessel safely endured grounding or collision which would have sunk a wrought-iron one.

At John Brown and Company's Works[b] more than four thousand very large steel boiler-front-plates were made in the five years ending in 1887, being "flanged at one heat all the way round, and without a single failure."

H. Goodall[c] states that, of 4,464 wrought-iron plates which he has used for boiler-making since the introduction of steel for boilers in 1875, 2·68% were defective and 0·2% spoilt in working, or together 2·88%: while of 4,236 steel plates which he used in the same time 1·04% were defective and 0·68% spoilt in working, or together 1·72%: and of this a considerable proportion seems justly chargeable to his workmen's lack of experience with the new material.

W. Parker[d] states that not an accident has occurred under steam among the upwards of 4,000 steel marine boilers built, which represent over 160,000 tons of steel. The Maginnis case, however, suggests that boiler explosions may account for some of the cases in which steamers have been lost without tidings.

Next, it is probable that wrought-iron sometimes fails in the same mysterious way as steel, though strikingly few mysterious failures are reported in case of the former metal. Stromeyer reports two cases, one in which on examining a wrought-iron boiler which had been out of use for about three months, he found a crack twenty-three inches long, extending from one plate into the next, and doubtless, he says, formed within twelve hours previous to his survey: the iron seemed soft in chipping. In the second a plate cracked quite across with a loud report during the dinner-hour, and about two weeks after the boiler was blown down.[e]

It is reported that, about the year 1848, the wrought-iron boiler-furnaces of the British-built steamer Leipzig cracked down the sides after several trips to Hamburg and back, just as in the Maginnis case.[f]

[a] Idem, p. 50.

[b] J. D. Ellis, discussion of Goodall's paper on "Open-hearth Steel for Boiler-making," excerpt Proc. Inst. Civ. Eng., XCII., p. 40, 1888.

[c] Idem, p. 25.

[d] Discussion of Stromeyer's paper on "the Working of Steel," Excerpt Proc. Inst. Civ. Eng., LXXXIV., p. 40, 1886.

[e] Idem, p. 76.

[f] J. Harrison, letter to "The Engineer," LX., p. 504, 1885. I have, unfortunately, little ground for judging how accurately the circumstances of this failure have survived the thirty-five years which elapsed before Mr. Harrison's brief notice of it appeared.

Several inquiries, which I have addressed to engineers whose prolonged experience has been of such a nature as to give them unusual opportunities for observation, have failed to bring to light other failures of wrought-iron boilers which could reasonably be classed as mysterious.

The liability to injury through cold- and blue-working, through local heating, overheating, unduly high finishing temperature, etc., probably increases rapidly both as the percentage of carbon and as that of phosphorus increase. Moreover, the liability to injury by improper heat treatment is probably greater in ingot- than in wrought-iron. Further, heterogeneousness, whether from segregation or imperfect mixing, probably increases the liability to injury. Finally, injury actually received from certain of these causes seems to increase greatly the liability to injury through certain others: overheating and too high finishing temperature to increase the liability to injury through local heating and cold-working, though on this point one may not speak too positively.

In view of these facts, ignoring our natural dread of the untried, we can see three simple reasons why the treachery of steel, once so serious a thing, is now almost of the past.

First, the steel-maker has learnt by experience. He knows to-day far better the effects of a high percentage of carbon or of phosphorus, of cracks, pipes and blowholes, of segregation and imperfect mixing, of over heating, of finishing too hot and too cold. Knowing, he guards against them more effectually, and keeps at home much steel that he would formerly have sent into the market. Those who would not or could not learn and do, have been driven out of the business: the conditions necessary for producing good sound steel by the acid Bessemer and open-hearth processes have been mastered. By and by the basic process came along, with new conditions, new liabilities to unsoundness, a great hue and cry about mysterious fractures followed, and Lloyd's Register provisionally forbade the use of basic steel.[g] Much basic steel was irregular, much brittle throughout: too much carbon, too much phosphorus, too cold teeming, imperfect mixing. Still there was little doubt that, with further experience, these difficulties of the basic process would be mastered as those of the acid process had been. Later still, coming to the present time, these difficulties yield more and more.

A second reason is that steel-users have learnt better what steel will and what it will not endure. It is difficult to estimate the importance of this. On the one hand eminent steel-users[h] insist that they treat steel exactly like wrought-iron, or even more severely, yet with perfect impunity. Many excellent American boiler-makers are absolutely ignorant of the injury caused by blue-working

[g] This occurred on December 17th, 1885, and from then at least till July 27th, 1887, no basic steel was used in vessels classed at Lloyd's. (Martell, "On the Present Position Occupied by Basic Steel." Excerpt, Proc. Inst. Nav. Arch., XXVIII., 1887.) On the day last mentioned, however, W. H. White reported that a small trial lot of basic steel ordered by the Admiralty for the less important parts of vessels, though in part severely tested in working, behaved so well as to show that basic steel could be used confidently for such purposes. ("On Some Recent Experiments with Basic Steel," idem.)

Lloyd's Register now permits the use of basic steel for ship and marine boiler-work, provided that it be made at works inspected and approved, and that it passes the specified tests. (Wm. Parker, Chief Engineer-Surveyor to Lloyd's. Private communication, Feb. 5th, 1889.)

[h] J. Ward, Trans. Inst. Nav. Arch., XXVII., p. 66, 1886, speaking of the remarkable success of his firm in steel ship-building, states not only that in his yard steel receives the same treatment as wrought-iron (save the annealing of certain straps) but that "no amount of instruction would ever gain it better or different treatment at the hands of the workmen than (wrought-) iron has always had." H. H. West echoes these statements (idem, p. 127).

by punching, etc.: full well I know that look, sometimes puzzled, oftener pitying, which a question as to the advisability of avoiding a blue heat, of drilling or reaming, of annealing after severe abuse, calls forth.

Now it seems clear that steel endures certain kinds of abuse much better than wrought-iron, and here it is probably treated as badly and perhaps worse than wrought-iron. But it is probable that other forms of abuse, such as local heating and over-heating, injure it more than wrought-iron. And it seems to me very probable that it is partly because we know and avoid these that we have fewer accidents with ingot-iron to-day than formerly. Several skilled American ship-builders assure me that they still have as many if not more accidents with ingot- than with wrought-iron: and this seems readily explained by supposing that their foremen and workmen do not yet understand the metal's weaknesses fully, for I know that they use admirable metal.

Again, a ship-builder's statement, that in his yard steel is treated exactly like wrought-iron, must be received very cautiously: for differences, apparently slight but really important, arise insensibly, imperfectly realized by ship-builder, foreman or even workmen. Owners of iron-working establishments have assured me, and I believe honestly, that ingot- and wrought-iron were treated exactly alike by their men: within five minutes their blacksmiths have assured me that they dared not heat ingot-iron as highly as wrought-iron, though they were not sure that if they did the ingot-iron would be injured. Ignore not the personal equation: your admirer will e'er minimize, your distruster exaggerate your faults.

THE EFFECT OF WORK.

§ 295. The almost self-evident proposition that wrought-iron,—consisting originally of but slightly adherent particles, and, after fagotting, of wholly inadherent bars,—should be greatly strengthened and toughened by work, abundantly proved by experience, led naturally to the belief that ingot-metal would be similarly improved. We will first consider the actual improvement due to work, and then its rationale.

TABLE 131.—RELATION BETWEEN THICKNESS AND PHYSICAL PROPERTIES OF IRON AND STEEL BARS, PLATES, ETC.

The composition and treatment of the members of each group are believed to be nearly alike, the thickness alone varying considerably.

	Authority.	Description.	Thickness, etc.		Percentage of excess of tensile strength, etc., over that of thickest member of group.				Tensile strength, pounds per square inch.	Elastic limit, pounds per square inch.	Elongation.		Contraction of area, %.
			Absolute, inches.	In percentage of thickness, etc., of thickest member of group.	Tensile strength.	Elastic limit.	Elongation.	Reduction of area.			%	In.	
			A.	B.	C.	D.	E.	F.	G.	H.	I.		J.
1.	D.	Terre Noire soft ingot-steel, natural state	0·87	100					62,740	39,600	20·62	7·87*	29 62
	"		0·43	49	+ 3·76	+ 3·23	+ 8·14	+ 68·23	65,100	40,880	22·30	"	49·82
	"		0·20	23	+ 5·17	+ 0·54	— 4·46	+ 43·85	65,980	39,824	19·70	"	42·60
	"		0·10	12	+ 26 70	+ 49·01	— 61 20	— 6·46	79,490	59,010	8·00	"	27·70
2.	"	Terre Noire soft ingot-steel, annealed	0·87	100					58,314	30,890	23·60	"	43·40
	"		0·43	49	— 1·05	— 12·52	— 9·92	+ 6·57	57,690	27,023	21·26	"	46·25
	"		0·20	23	+ 3·05	— 18·97	— 8·05	— 8·30	60,080	24,740	21·70	"	39·80
	"		0·10	12	+ 1·71	— 4·70	— 29·66	— 27·19	59,300	29,440	16·60	"	31·60
3.	"	Terre Noire soft ingot-steel, quenched in water of 28° C. from a rather dark red	0·87	100					86,340	41,020	15·30	"	32·35
	"		0·43	49	— 3·35	— 10·23	— 12·42	— 13·07	83,470	36,830	13·40	"	28·12
	"		0·29	23	+ 4·78	— 11·61	— 42·03	— 35·09	90,470	36,260	8·87	"	21·00
	"		0·10	12	+ 5·40	— 16·81	— 51·63	— 6·12	91,026	34,134	7·40	"	30·37
4.	R.	432 tests of 54 plates rolled from 12 ingots from a single heat of open-hearth steel. Unannealed.	1·00	100					61,940		22·82	....	33·47
	"		0·50	50	+ 3·87		+ 4·60	+ 24·89	64,330		23·87	....	41·80
	"		0·25	25	+ 12·30		— 5·79	+ 19·15	69,550		21·50	....	39·88
	"	Annealed.	1·00	100					59,180		27·02	....	44·42
	"		0·50	50	+ 3·10		— 0·70	+ 6 82	61,040		26·83	....	47·45
	"		0·25	25	+ 6·17		— 13·47	+ 1·36	62,830		23·38	....	45·025
5.	B.			100					68,400		21·75	....	42·5
	"			42·87	+ 6·03		— 4·60	+ 3·76	72,520		20·75	...	44·1
	"			28·58	+ 8·11		— 10·35	— 1·18	73,940		19·5	....	42·0
	"			14·29	+ 15·59		— 17·24	— 4·00	79,060		18·0	....	40·8
6.	"			100·00					66,980		22·3	....	47·0
	"			42·87	+ 3·18		— 23·77	+ 4·26	69,110		17·0	....	49·0
	"			28·58	+ 8·28		— 10 81	— 13·62	72,520		20·0	....	40·6
	"			14 29	+ 8·92		— 1·34	+ 2·34	72,950		22·0		48·1
7.	"			100					71,950		22·7	....	42·7
	"			50	+ 7·51		— 15·42	+ 0·70	77,360		19·2	....	43·0
	"			25	+ 11·86		— 29·52	— 1,64	80,490		16·0	....	42·0
8.	"			100					71,530		23·7	....	53·6
	"			50	— 0·60		— 17·72	— 2·80	71,100		19·5	....	52·1
	"			25	+ 5·96		— 40·93	— 11·57	75,790		14·0	....	47·4
9.	L.	Averages of many (about 500) tests of steel boiler plates made for an American engineer; all made and tested at the same mill	0·75	100					63,000	32,000	25	15"	
	"		0·56	75	— 4·76	+ 15·62			60,000	37,000	25	"	
	"		0·50	67	— 6·35	+ 25·00			59,000	40,000	25	"	
	"		0·44	59	— 6·35	+ 25·00	— 4·00		59,000	40,000	24	"	
	"		0·37	49	— 7·94	+ 28·12	— 4·00		58,000	41,000	24	"	
10.	G.	Bars $2\frac{1}{2}'' \times \frac{5}{8}''$	0·617	100					61,272		26·05	8	
	G.	Angles rolled from them	0·380	62	+ 3·85				63,631		26·05	"	
12.	W.	Swedish Bessemer billet, 1·2" square, carbon 1·5%	1·5	100					88,330		0·10	10	
	"	The same annealed	1·5	100	— 41·82		+ 1·50		51,388		0 25	10	
	"	" " rolled down to $\frac{3}{4}''$ square	0·75	50	+ 20·48		+ 1900·00		106,667		2·00	10	
14.		Mean of 48 sets of tests by Kirkaldy on open hearth steel plates	1	100					69,880	42,670			
			0·75	75	— 7·85	— 17·32			64,395	35,280			
			0·50	50	— 6·08	— 17·59			65,630	35,165			
			0·25	25	— 10·24	— 22·05			62,720	33,262			
15.		Parker. 1¼" boiler-plate	1·25	100					67,200@76,160		21·3@28·1	8	
		¼" plate of similar metal	·50	40	+ 19·58		— 8·91		78,400@91,849		21 @24	8	
16.		H. Allen. Billet, and wire rods rolled from it. Soft steel	2" sq.	100					62,999	38,170	28 1	....	53·95
			0·30	15	+ 8·01	+ 25·35	— 18 86	+ 10·14	67,939	47 846	22·8	....	59·42
			0·284	14	+ 2·53	+ 19 54	— 29·54	+ 20·07	64,490	45 629	19·8	....	64·78
			0·238	12	+ 7·76	+ 28·58	— 27·78	+ 23·08	67,782	49,078	21·7	....	66·40
			0·220	11	+ 5·20	+ 22·83	— 23·13	+ 26·25	66,170	46,883	21·6	....	68·11

1 to **3.** From the same cast of soft steel, one ingot 13·8 inches × 8·7 inches was rolled to a plate 0·87 inches thick, which was cut in two, one half tested, the other rolled down to 0·10 inches. A second ingot, 8·7 inches square was rolled to 0·43 inches, cut in two, one half yielding the test-piece, the other being rolled to 0·1. V. Deshayes, Ann. Mines, 7th series, XV., p. 345.

4. J. Riley, Journ. Iron and Steel Inst., 1887, I., p. 121.

5 to **8.** Braune, Ledebur, Handbuch, p. 655, from Stahl und Eisen, 1883, p. 4.

9. 36 to 40 private notes.

10. Gatewood, Rep't. U. S. Naval Advisory B'd on Mild Steel, 1886, pp. 67-8. From each of 19 heats of Cambria open-hearth steel, pieces from flats $2\frac{1}{2}'' \times \frac{5}{8}''$ were tested, and also pieces from angle-irons rolled from these flats, in all 95 tests. In every case the tensile strength of the angle-iron exceeded that of the flat. The angle-irons, however, were not tested on the same machine as the flats.

12. M. White, private communication.

14. Rept. U. S. Naval Advisory B'd on Mild Steel, 1886-1885, p. 133, from British Parliamentary paper, C 2897, London, 1881.

15. W. Parker, "Experience in the Use of Thick Steel Boiler-plates," Inst. Naval Architects, 1885.

16. Pieces from a 2 inch square soft steel billet, carbon 0·115, silicon 0 009, phosphorus 0·072, are rolled hot to wire-rods of the diameters given. The wire-rods were annealed before testing, the billet apparently was not. The properties of the unannealed wire-rods are also given in the original, but they do not differ greatly from those here given. H. Allen, excerpt Proc. Inst. Civ. Eng., XCIV., 1888. The density of these specimens is given in Table 431.

§ 296. Relation between Thickness of Piece and Testing-Machine Properties.

A. Ingot-iron.—Let us first study the effect of varying thickness with one inch as a maximum, and then for greater thicknesses.

1. *Pieces 1″ thick and less.*—Numbers 4, 9 and 10 of Table 131, collectively representing more than 1,000 tests for each property, indicate that thin plates do not excel thick ones in ductility, at least not in elongation: while as to tensile strength their teaching is contradictory, the thin plates excelling the thick in 4 and 10, but being excelled by them in 9. It is not improbable that this discrepancy is due to differences in the conditions of rolling: possibly the plates of Number 4 were finished so cold as to increase their tensile strength: for we find that in the case of the annealed plates of Number 4 the thin are but little stronger than the thick. So with Numbers 1 and 2 of table 131, and so with the half-inch pieces (Nos. 5 and 11) in table 134, which when annealed are not markedly stronger than the inch pieces. The elastic limit in Number 9, table 131, increases as the thickness decreases, though the tensile strength at the same time diminishes.

The indications, then, seem to be that thinner pieces of soft steel may, but do not necessarily, excel similar ones one inch thick in tensile strength and elastic limit: that they are likely to be less ductile than the one-inch pieces: and that, if heated (*e. g.* for annealing) they are likely to lose much of their excess (if any there be) of tensile strength and elastic limit, while recovering their deficit of elongation.

2. But when we come to pieces as thick or thicker than one inch, the case is different. Of these Kirkaldy

Table 132. Influence of the Early vs. the Late Reductions on the Physical Properties of Ingot-iron (Kirkaldy, Fagersta Steel, Series C3, 0·15% Carbon.)

		Percentage of increase of properties in reducing from 3″ × 3″ to 1″ × 1″ Early Reductions.				Percentage of increase of properties in reducing from 1″ × 1″ to ½″ × ½″. Late Reductions.			
		Tensile strength.	Elastic limit.	Elongation.	Reduction of area.	Tensile strength.	Elastic limit.	Elongation.	Reduction of area.
Unannealed	Hammered	15·2	71·1	—38·9	53·5	10·6	18·3	—34·4	—8·24
	Rolled.....	3	36·2	—10·6	20·6	11·4	8·3	—20·1	3·3
Annealed...	Hammered	6·2	21·5	—42·3	33 3	3·8	6·7	—16 0	7·6
	Rolled	5·9	28·2	— 5·8	14 2	—1·1	4·1	—25	6·4

Table 133.—Influence of Work or Reduction on the Properties of Iron.

Percentage of increase of tensile strength, etc., due to each 1% of diminution of sectional area by hammering.

Number.	Diminution of cross-section. Size of piece, inches. Initial.	Final.	Diminution per 100 of original.	Prop't'n of carbon	Gain in tensile strength, %. B1. 0·8%.	B2. 0·6%.	B3. 0 4%.	B4. 0·2.	Average.	Gain in elastic limit, %. B1. 0·8%	B2. 0·6%.	B3. 0·4%.	B4. 0·2	Average.	Gain in elongation, %. B1. 0 8%.	B2. 0 6%	B3. 0·4%.	B4. 0·2	Average.	Gain in contraction of area, %. B1. 0·8%.	B2. 0·6%.	B3. 0·4%	B4. 0·2	Average.
												Unannealed Steel.												
1	6 × 6	5 × 5	30·6	.....	·09	—·21	·39	·18	·11	·13	·05	·18	·46	·20	0·89	—0·98	1·87	2·23	1 00	0·65	—0·92	1·25	0·38	0·34
2	5 × 5	4 × 4	36·0	.....	·30	·63	·47	·12	·38	·33	·29	·23	·55	·35	0·60	2·78	4·19	1·08	2 16	0·62	4·32	6·13	2·92	3·50
3	4 × 4	3 × 3	43·7	.....	·24	·33	·04	·05	·17	·12	·13	·25	·29	·20	0·27	1·96	0·48	—0·10	·65	0·10	2·09	3·15	0·34	1·42
4	3 × 3	2 × 2	55·6	.....	·31	·17	·03	·02	·13	·26	·07	·17	·06	·14	0·28	1·73	0·13	—0·24	·48	0·70	4·01	0·42	0·03	1·29
5	Average	of 1 to 4	....	.....	·23	·23	·23	·09	·20	·21	·14	·21	·34	·22	0·51	1·37	1·67	0·74	1·07	0·52	2·38	2·74	0·92	1·64
6	6 × 6	2 × 2	88·9	.....	·53	·49	·40	·15	·39	·44	·27	·43	·66	·43	1·12	4·61	4·63	1.06	2·85	1·28	11·66	12·94	4·67	7·64
												Annealed Steel.												
7	6 × 6	5 × 5	30·6	.....	·04	—·61	·48	·02	—·02	·04	·09	·27	·44	·21	0·19	—2·27	1·71	∞	.....	2·98	—2·60	1·91	0·69	0·74
8	5 × 5	4 × 4	36·0	.....	·36	·72	·40	·20	·42	·21	·15	·19	·67	·31	1·85	2·01	6·21	0·38	2·61	1·27	2·33	9·17	1·50	3·57
9	4 × 4	3 × 3	43·7	.....	·08	·39	—·03	—·07	·09	·15	·11	·14	·22	·16	0 61	4·18	—0·19	1·02	1·40	1·11	9·10	1·27	0·52	3·00
10	3 × 3	2 × 2	55·6	.....	·20	·12	·06	·04	·10	·09	·18	·25	·12	·16	0·81	0·14	0·01	—0·46	0·12	1·00	1·12	0·06	0·05	0·56
11	Average	of 7 to 10	.....	.....	·17	·15	·23	·05	·15	·12	·13	·21	·36	·21	0·86	1·01	1·94	.....	.....	1·59	2·49	3·10	0 69	1·97
12	6 × 6	2 × 2	88·9	.....	·40	·27	·38	·08	·28	·25	·28	·45	·72	·42	2·51	0·86	3·99	0·25	1·90	3·02	2·32	11·34	1·53	4·55

This table is calculated from Kirkaldy's data, "Experimental Enquiry into the Mechanical Properties of Fagersta Steel, 1873." It gives the increase of tensile strength, etc., due to a unit of diminution of sectional area by forging. This increase for each particular reduction (*e. g.* from 4 × 4 to 3 × 3) is measured in percentages of the tensile strength, etc., which the metal has when of the initital area, in this case 4 × 4. The unit of diminution of area is one per cent. of said initial area, in this case $\frac{4 \times 4}{100} = 0{\cdot}16$ square inches. *Example.* To find the gain in tensile strength or unannealed steel B3, due to a unit of diminution of area, while being hammered from 4 × 4 to 3 × 3. Tensile strength of the 4 × 4 piece, 72,260 pounds per square inch: of the 3 × 3 piece, 73,580. Gain $= \frac{1{,}320 \times 100}{72{,}260}\% = 1{\cdot}827\%$. Diminution of area $= \frac{(4 \times 4) - (3 \times 3)}{4 \times 4} \times 100\% = 43{\cdot}75\%$. Gain per 1% diminution of area $= \frac{1{\cdot}827}{43{\cdot}75} = 0{\cdot}04\%$. The results for the other properties are obtained mutatis mutandis.

Table 134.—Influence of Work or Reduction on the Properties of Iron. (Rolling. Kirkaldy's Data).

I. Percentage of excess (+) or deficit (—) of the tensile strength of smaller steel bars over the tensile strength, etc., of similar 3″ square bars.

Number.	Size of piece. Absolute, inches.	In percentage of sectional area of 3 × 3 bar.	Tensile strength. C 1 1%	C 2 0·5%	C 3 0·15%	Elastic limit. C 1 1%	C 2 0 5%	C 3 0·15%	Elongation. C 1 1%	C 2 0·5%	C 3 0·15%	Contraction of area. C 1 1%	C 2 0·5%	C 3 0·15%
						Unannealed Ingot-Steel and Ingot-Iron.								
1	2½ × 2½	69·44	+ 11	+ 16	+ 8	+ 7	+ 20	+ 10	+ 33	+ 228	— 35	+ 80	+ 134	— 46
2	2 × 2	44·44	+ 24	+ 35	+ 8	+ 8	+ 26	+ 20	+ 167	+ 536	— 8	+3900	+ 373	— 10
3	1½ × 1½	25·00	+ 47	+ 27	+ 4	+ 11	+ 33	+ 28	+ 317	+ 308	+ 12	+ 820	+ 259	— 3
4	1 × 1	11·11	+ 71	+ 41	+ 3	+ 20	+ 42	+ 36	+ 916	+ 548	— 11	+2300	+ 566	+ 21
5	½ × ½	2·78	+ 85	+ 45	+ 15	+ 31	+ 54	+ 48	+1116	+ 540	— 29	+3900	+ 877	+ 25
						Annealed Ingot-Steel and Ingot-Iron.								
7	2½ × 2½	69·44	+ 11	+ 19	+ 6	— 5	+ 18	+ 14	+ 90	+ 263	— 15	+ 104	+ 557	— 6
8	2 × 2	44·44	+ 25	+ 33	+ 11	+ 5	+ 31	+ 23	+ 130	+ 842	— 23	+ 96	+ 620	— 3
9	1½ × 1½	25·00	+ 49	+ 37	+ 8	+ 21	+ 37	+ 25	+ 135	+ 300	— 31	+ 182	+ 617	6
10	1 × 1	11·11	+ 63	+ 39	+ 6	+ 38	+ 45	+ 28	+ 200	+ 197	— 6	+ 543	+ 635	+ 14
11	½ × ½	2·78	+ 76	+ 33	+ 5	+ 46	+ 49	+ 33	+ 325	+ 158	— 29	+ 971	+ 844	+ 21

II. Percentage of increase of tensile strength, etc., due to each 1% of diminution of sectional area by rolling, from 3 × 3 to ½ × ½.

						Unannealed Ingot-Steel and Ingot-Iron.								
13	½ × ½	2·78	+0·87	+ 0·46	+ 0·15	+11·48	+5·55	—0·30	+ 11·48	+5·55	—0·30			
						Annealed Ingot-Steel and Ingot-Iron.								
14	½ × ½	2·78	+0·78	+0·34	+ 0·05	.....	.....	.....	+ 3·34	+1·63	—0·30			

III. Percentage of increase of tensile strength due to 1% of diminution of sectional area by rolling from 1 × 1 to ½ × ½.

						Unnanealed.								
15	.....	.....	+ ·11	+ ·05	+ ·15	+ ·12	+ ·11	+ ·11	.....	.....	.....	+ ·89	+ ·62	+ ·04
						Annealed.								
16	.....	.....	+ ·10	.....	.....	+ ·08	+ ·04	+ ·05	.....	.....	.....	+ ·89	+ ·38	+ ·09

TABLE 135.—INFLUENCE OF THE PROPORTION OF CARBON ON THE INCREASE OF TENSILE STRENGTH, ETC., DUE TO FORGING, ETC. (Kirkaldy.)

			Unannealed steel.					Annealed steel.				
			B1 0·80% C.	B2 0·60% C.	B 3 0·40% C.	B4 0·20% C.	Mean.	B1 0·80% C.	B2 0·60% C.	B3 0·40% C.	B4 0·20% C.	Mean
Reduction from 6 × 6 inch ingots to 2 × 2 inch bars by hammering	Tensile strength increased by, %		46·8	43·5	35·8	13·3	36·1	35·5	24·0	33·6	6·7	25·3
	Elastic limit increased by, %		39·1	23·7	38·5	58·5	38·0	22·3	24·6	39·6	64·3	33·6
	Contraction of area increased by, %		113·	1036·	1150·	415·	626·	286·	209·	1008·	136	258·
			C1 1% C.	C 2 0·5% C.	C3 0·15% C.			C1 1% C.	C2 0·5% C.	C3 0·15% C.		
Reduction from 3 × 3 bars to ½ × ½ inch bars	Tensile strength increased by, %	Hammered	93·2	36·9	27·4	.....	54·2	73·1	17·9	10·2	.....	36·2
		Rolled	85·1	45·4	14·8	.....	52·6	75·5	33·3	4·8	.....	42·3
	Elastic limit " "	Hammered	53·2	101·8	102·5	.....	78·7	49·6	60·4	29·7	.....	47·8
		Rolled	30·6	53·9	47·6	.....	40·3	46·3	49·3	33·5	.....	44·3
	Elongation " "	Hammered										
		Rolled	1116·	540·	29·	.....	.....	325·	158·	— 29·		
	Contraction of area " "	Hammered	4900·	968·	41·	.....	169·	1462·	555·	43·	.....	148·6
		Rolled	3900·	877·	24·6	.....	115·	971·	844	21·	.....	120·

Calculated from Kirkaldy, "Experimental Enquiry into the Mechanical Properties of Fagersta Steel." The numbers in this table give the increase of tensile strength, etc., due to forging, measured in percentage of the tensile strength, etc., of the 6″ ingots in the first three lines, and measured in percentage of the tensile strength, etc., of the 3″ bars in the last eight lines.

gives twenty-four comparable pairs of cases of soft steel, in which the thinner differs from the thicker in size only: here the thin excels the thick in elastic limit in 22 cases, or 91·7% of the whole, in contraction of area in 21 cases, and in tensile strength in 18 cases, or 75% of the whole (columns B4 in table 133 and C3 in table 134).[a]

Table 132 indicates that the reduction from 3″ to 1″ square increases the elastic limit and contraction of area for soft steel much more than that from 1″ to ½″, without corresponding difference in case of tensile strength.

B. *Ingot-Steel.*—In the cases before us the tensile strength and ductility of ingot-steel are increased very much more than those of ingot-iron by reduction of thickness: but as regards the gain in elastic limit, ingot-iron and steel stand more nearly on a par, that of ingot-iron being greater than that of ingot-steel in Table 133, while in Table 134 neither class has a decided advantage.

Out of 64 pairs of comparable cases of ingot-steel in Kirkaldy's work, the tensile strength, elastic limit, and contraction of area of the thinner excel those of the thicker pieces in 56, 61 and 58 cases respectively, or in 87·5, 95·3, and 90·6% of the total number of cases.

Taking all of Kirkaldy's Fagersta cases together, I can trace no simple relation between the proportion of carbon and the effect of reduction on the elastic limit, whether for annealed or unannealed metal, nor on the ductility for annealed metal: but, within the limits carbon 0·60% and 0·15%, for given diminution of area by hot work, the *higher the carbon the greater the gain in tensile strength for both annealed and unannealed metal*, and in ductility for unannealed metal (Table 135).[b]

2. *Annealed vs. Unannealed.*—If E = the percentage of excess (due to hot working) of any given property in an unannealed bar over that of the unannealed bar or ingot from which it is made, and if E′ = the corresponding excess for annealed steel: then we learn from Tables 133 to 135 that, in case of 2″ bars from 6″ ingots and of ½″ bars from 3″ bars, E for tensile strength is almost always and E for elongation usually greater than E¹, but not for elastic limit or contraction of area. Nor does E appear on the whole to be greater than E¹ for any of these properties in case of bars of intermediate size made from 6″ ingots and from 3″ bars. In other words, in Kirkaldy's experiments, hot-working appears to increase the elastic limit and contraction of area belonging to the annealed state probably about as much on the whole as those belonging to the unannealed state; and the tensile strength and elongation belonging to the annealed state in very many cases as much as those belonging to the unannealed state.

But in numbers 1, 2 and 4 of Table 131 E is greater than E¹ for elastic limit and tensile strength.

This indicates that the improvement differs from that induced by cold-working, which is lessened by annealing. (Cf. § 271, p. 217).

3. *Early vs. Late Reduction.*—If i = the percentage of increase of any property following an amount of hot working which diminishes the sectional area of the piece by 1%, then we find in Table 133 that, for each of the four properties, i is greater when the size is reduced from 5 in. × 5 in. to 4 in. × 4 in. than for either earlier or later reductions. This is true in 83 out of the 96 cases in which i for other reductions is compared with i for reductions from 5 × 5 to 4 × 4. In other words, under these conditions a given percentage of diminution of area between 5 in. × 5 in. and 4 in. × 4 in. does more good than either earlier or later diminutions. Further, i is greater here for reduction from 5 in. to 4 in. than from 4 in. to 3 in. in 28 out of 32 cases; and for 4 in. to 3 in. than for 3 in. to 2 in. in 21 out of 32 cases. Whether this is due to the special conditions of these cases or not, further investigation must

TABLE 136.—IMPROVEMENT OF WROUGHT-IRON F WITH DIMINISHING SIZE.
U. S. Board on Testing Iron, etc., I., p. 38, 1881.

Size of bar. Inches.	Sectional area of pile. Inches.	Sectional area of bar in per cent of area of pile.	Tensile strength, pounds per square inch.		Elastic limit, pounds per square inch.	
			Entire bar.	Core.	Entire bar.	Core.
4	80	15·70	.....	46,322	.....	23,430
3½	80	13·80	.....	46,667	.....	23,636
3¼	80	12·03	.....	47,000	.....	24,951
3	80	10·37	.....	47,014	.....	24,591
2¾	80	8·83	.....	47,761	.....	26,387
2½	80	7·42	.....	46,466	.....	26,333
2¼	80	6·13	47,344	47,428	29,758	29,941
2	72	5·52	48,505	49,290	31,237	32,163
1¾	72	4·86	47,872	48,280	35,864	31,892
1½	36	7·67	49,144	49,370	35,615	37,042
1¼	36	6·68	50,547	48,792	35,954	38,992
1	36	5·76	50,529	49,144	35,394	34,208
1¼	36	4·90	50,820	51,838	35,087	36,467
1⅛	36	4·12	52,339	48,819	39,103	.....
1	36	3·41	52,729	49,801	39,608	40,534
⅞	25	3·96	50,149	50,530	35,493	37,771
¾	25	3 14	51,921	51,128	39,066	38,596
⅝	12½	4 91	50 716	50,374	33,931	33,204
½	12½	3·60	50,673	50,276	33,933	35,933
⅜	12½	2 50	52,297	51,431	34,450	34,545
⅝	9	2·17	52,275	52,775	38,445	39,126
¼	9	3 68	54,098	54,108	38,475	40,213
⅜	3	1·60	57,000	59,585	Lost.	Lost.

NOTE.—The number 3·68 in the third column for the ¼″ bar is given thus in the original. Apparently it should be 1·22.

[a] The elongation of the different sizes in Kirkaldy's experiments is not comparable, because the different test-pieces had unlike diameters.

[b] For the effect of annealing as influenced by the proportion of carbon, see § 46, p. 4. Mr C. A. Marshall announces it as a law that the effect of work is greater and that of heat-treatment less on the physical properties of low- than of high-carbon steel. Doubtless true as regards certain forms of heat-treatment, *e. g.* quenching, this harmonizes poorly with our inferences from Kirkaldy's data as regards work: and in this respect it is also opposed to Metcalf's judgment and experience. Trans. Am. Soc. Civ. Eng., XV., pp. 349, 351, 1887.

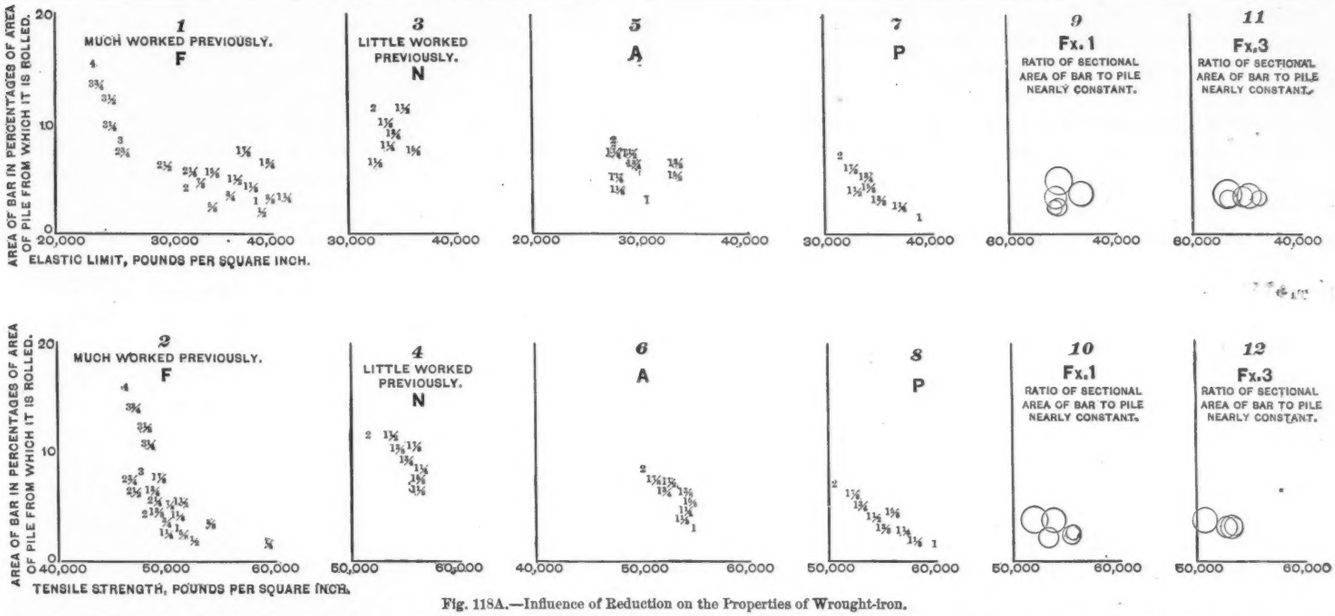


Fig. 118A.—Influence of Reduction on the Properties of Wrought-iron.

The diagrams are to be taken in pairs, 1 with 2, 3 with 4, etc. The tensile strength (even-numbered diagrams) and elastic limit (odd-numbered diagrams) of wrought-iron bars were determined, and the results here plotted. Each pair of diagrams represents results obtained with many bars of the same kind of wrought-iron, but of different thicknesses and produced with different amounts of reduction from the pile from which they were made. The numerals in diagrams 1 to 8 inclusive represent the thickness of the bars tested, in inches. In diagrams 9 to 12 inclusive the results fell so closely together that numerals would have obscured each other: the thickness of the bar is therefore represented in these diagrams by the size of the circles. The results are those of the United States Test Board, Rept. 1881.

decide: but, taken collectively, the evidence here presented seems to indicate pretty strongly that the improvement is on the whole more marked and constant for reductions between large sizes than for those between small sizes, especially when the small sizes are materially below one inch.

Quantitative Effect of Work.—Table 133 indicates that, under the conditions here existing, if the sectional area of the piece be reduced by from 30 to 45% by hot-working, then on an average each 1% of diminution of area increases the tensile strength and elastic limit by about 0·2% and the elongation and contraction of area by about 1·5%.

To sum up, diminution in the thickness of ingot-metal is usually but not necessarily accompanied by an increase in tensile strength, elastic limit and ductility: the exceptions are more numerous in case of ductility than of the two other properties, and in case of thin ingot-iron than in other cases. The increase of tensile strength and contraction of area, but apparently not that of elastic limit, usually increases with the proportion of carbon, at least till this reaches 0·6%. The increase is on the whole greater for the early than for the late reductions, and, while often as great in case of annealed as in that of unannealed metal, the latter class in many and perhaps most cases gains most. To verify these inferences, which are only provisional, the study of a much larger number of cases is necessary.

C. *Weld-Iron.*—The results of the United States Test Board, represented graphically in Figure 118A, diagrams 1 to 8, indicate that the tensile strength and elastic limit of weld-like those of ingot-metal increase as the thickness diminishes.[a] In Table 136, the improvement, though halting, continues down to the smallest size reached, $\frac{1}{4}''$. From $1\frac{1}{4}''$ to $\frac{3}{4}''$ there is little change: from $\frac{3}{4}''$ to $\frac{1}{4}''$ the improvement is marked.

§ 297. Influence of the Thickness of the Ingot or Pile on the Properties of the Resulting Bars, Etc.—The examples in Tables 137–8 seem to indicate that the properties of ingot-iron plates are independent of the size of the ingot from which they are made. Table 137 gives a case in which pieces of various thicknesses were cut from an ingot and rolled down to plates $\frac{1}{2}''$ and $\frac{1}{4}''$ thick. Pieces $\frac{1}{2}''$ and $\frac{1}{4}''$ thick were also cut directly from the ingot.

Table 137.—Influence of the Initial Thickness of the Ingot from which they were Rolled on the Properties of Steel Plates. (Parker).

		Tensile strength, pounds per square inch.	Elongation in 8 inches.
These pieces were all cut from one and the same ingot.	Piece 15 inches thick drawn down to ½ inch	58,016	27·0
	" 12½ " " " "	59,136	27·0
	" 10 " " " "	59,360	26·0
	" 7½ " " " "	58,688	24·0
	" 5 " " " "	58,912	22·0
	" 5 " " " "	58,464	24·0
	" 3 " " " "	58,896	25.5
	" 2 " " " "	58,240	26·0
	" 1 " " " "	58,240	27·0
	" cut direct from the ingot, ½-inch thick	49,280	9·0
	" 15 inches thick drawn down to ½ inch	63,168	24 5
	" 12½ " " " "	65,184	22·5
	" 10 " " " "	63,168	22·0
	" 7½ " " " "	66,528	16·0
	Piece cut direct from the ingot	52,864	10*
	The same piece after testing, hammered to ½ in. sq.	71,904	11*
	Common plates from the same charge	60,928	25*
		59,584	27*
	Piece 1¼ cut from ingot and rolled to ¾ inch round	68,544	23*

Journ. Iron and Steel Inst., 1887, I., pp. 133–4; also 1883, I., p. 100.

Table 138.—Influence of Thickness of Ingot on Properties of Steel Plates

	Size of ingot.	Thickness of plate.	Number of tests.	Tensile strength pounds per sq. in.	Elongation in 8 inches.	Contraction of area.
1	12″ × 6″	0·25″	16	65,500	21·8	38·2
2	24″ × 15″	0·25″	32	68,000	20·8	44·2
3	Thickness 7″	0·25±	11 to 15	55,820	29·6	60·2
4	" 12″	0·24	2	52,250	32·5	57·25
5	" 18″	0·258	2	60,115	33	57·75

1 and **2.** From two ingots 24″ × 15″ four slabs 8 inches thick were forged, and from two ingots 12″ × 6″ from the same cast two slabs 4 inches thick. These six slabs were rolled to plates ¼ inch thick, and from each plate eight tensile tests were made. The results are calculated from J. Riley's data, Journ. Iron and Steel Inst., 1887, I., p. 122, Table I., and Abstract IV. Cf. J. Riley, Idem, 1883, I., p. 77.

3, 4 and **5.** A. E. Hunt, Trans. Am. Inst. Mining Engrs., XII., p 315. From ingots 7″, 12″ and 18″ thick, all from the same heat of open-hearth steel, of carbon 0·15% plates about 0·25″ thick were rolled. Those from the 7″ ingots were rolled direct from the ingot apparently: those from the 12″ and 18″ ingots were rolled from slabs 5″ thick, hammered from the ingots.

[a] The formulæ $T = \frac{60{,}000}{\sqrt[4]{d}}$ and $T = 52{,}000 - \frac{7{,}000\ A}{B}$, in which d = the diameter, A = the area and B = the periphery of the section, all in inches, and T = the tensile strength in pounds per square inch, are proposed by Thurston and the Edgemoor Iron Co. respectively. Thurston, Matls. of Engineering, II., p. 407, 1885.

While these latter pieces were weak and brittle, the strength and ductility of the rolled plate pieces seem quite independent of the thickness of the piece from which they were rolled.[a]

The examples in Table 139 similarly indicate that the tensile strength and elastic limit of wrought-iron bars of given size is, within the limits here given, independent of the sectional area of the pile from which they are rolled. At least the influence of the size of the pile is here so slight as to be wholly masked by that of other variables.

TABLE 139.—INFLUENCE OF THE INITIAL THICKNESS OF THE PILE FROM WHICH THEY WERE ROLLED ON THE PROPERTIES OF WROUGHT-IRON BARS.

From Data of U. S. Board on Testing Iron, Steel, etc., 1881, pp. I., 38 to 44.

2-inch square bars.							1¼" square bars.						
		Pile.		Bar.					Pile.		Bar.		
Number.	Name.	Size, inches.	Area, inches.	Area, % of area of pile.	Tensile strength, lbs. per sq. in.	Elastic limit, lbs. per sq. in.	Number.	Name.	Size, inches.	Area, inches.	Area, % of area of pile.	Tensilestrength, lbs. per sq. in.	Elastic limit, lbs. per sq. in.
1..	N.	6 × 4¾ × 26	27	11·63	51,848	32.461	1	N.	4 × 3¾ × 17	15	8·18	56,478	33,251
2..	A.	.....	36	8·72	50,171	27,600	2	A.	.....	25	4·90	53,879	27,600
3..	P.	.....	45	6·98	50,834	31 878	3	Px.	.....	31·5	3·89	56,334	33,921
4..	Px.	.....	49·5	6·35	52,599	31,198	4	F.	.....	36	3·41	49,801	40,534
5..	F.	.....	72	4·36	48,280	31,892	5	Fx. 3	6 × 6	36	3·41	53,248	33,520
6..	Fx. 1	8 × 10	80	3·93	52,011	34 702	6	P.	.....	45	2 72	56,871	36,868
7 .	Fx. 3	8 × 10	80	3·92	50,763	33,258	7	Fx. 1	6 × 8	48	2·55	55,307	34,784

§ 298. RATIONALE OF THE EFFECT OF WORK.—We can con-ceive six ways in which hot-working may influence the properties of iron and steel:

Mechanically
1, by expelling slag and by changing its distribution.
2, by welding together separate particles or pieces which were initially more or less detached. These two apply chiefly to weld-iron.
3, by closing blow-holes and pipes.

Structurally, 4, by preventing or obliterating crystallization.

Specially
5, by pressure as such.
6, by kneading as such.

Care is needed, especially in case of thin and hence cool-finished pieces, to distinguish the results of hot- from those of cold-working: the latter are probably more thoroughly removed by annealing than the former. Again, the increase of elastic limit probably bears a higher ratio to that of tensile strength in case of cold- than of hot-working. Further, while hot-working toughens, cold-working makes brittle: whence we infer that the cold-working range of temperature has been reached in the following case.

TABLE 139A.—NORMAL AND COOL WORK. BRYAN.

Rolled at	Tensile strength, lbs. per sq. in.				Elongation.			
Bright redness.....	70,345	69,942	63.135	59,190	25 9	24·3	24 9	28·3
Dull "	70,573	71,954	64,060	61,590	22 4	22·6	22 8	24·5

Rept. Naval Advisory Bd. on Mild Steel, Gateswood, p. 92, 1886. Part of each of four heats of Cambria "cruiser" steel was rolled at bright redness, part at dull redness. The finishing-temperature is not given.

Of the above six ways, the first three are mechanical. That work may benefit thus is self-evident. The expulsion of slag must occur chiefly during the early part of each rolling or hammering, while the slag is liquid and the metal soft and open. Table 140 tends to show that little is removed in reducing wrought-iron from 2 in. to ⅝ in.

[a] The ¼" plates rolled from the 7¼" piece has low ductility, but this can hardly be attributed to its being rolled from a thin piece, as ½" pieces rolled from 5", 3", 2" and 1" pieces had shown high ductility.

TABLE 140.—INFLUENCE OF WORK ON THE PROPORTION OF SLAG IN WELD IRON.

Slag in chain-cable iron of various cross sections

Diameter of piece, inches.		⅝	¾.	1.	1¼.	1½.	1⅝ and 1 7-16.	1¾.	1⅞ and 1 11-16.	1¾.	1 13-16	2.
Percentage of slag.	Maximum	.....	.....	1·168	.....	1·096	1·738	1·724	1·926	1·230	.....	2 262
	Minimum	.....	.....	0·570	.....	0·650	0·192	0·326	0·308	0 354	.....	0 546
	Average .	·668	·388	·862	1·258	·873	1·058	0·959	·658	·943	0·376	1·223
Number of pieces....		1	1	3	1	2	6	5	5	4	1	4

This table is calculated from data furnished by the U. S. Board on testing iron, steel, etc., Rep., 1881, Vol. I., p. 223, Trans. Am. Inst. Mining Engineers, VI., p. 102, 1879.

The fourth is structural. Here the influence of work is of the same nature as that of heat-treatment.

The fifth and sixth may be called the special effects of work, which cannot be produced otherwise. By chemical additions and by compression in casting we can prevent mechanical defects: by heat-treatment we can in great measure govern the structure. But it is generally believed that work has a further influence: that its pressure and kneading as such work some lasting benefit which is not simply mechanical, which is not the same as that of heat-treatment, but which is comparable to the effect of kneading on clay, on dough, on putty. Let us term this the "special effect" of work.

Now it is a question, and a very important one, whether this special effect exists at all, whether "we want a forging machine at all," whether "the steel can be made to forge itself by static pressure and by heat"[b] with as good results as when forging is added to static pressure and heat: whether "it is possible" (and profitable) "to make a steel in its cast state just as strong as if it had been hammered"[c]: whether the superiority of thin over thick pieces even of mechanically sound ingot-metal (here excluding that improvement due to cold-working and removable by annealing) is due to increased reduction as such, or to the lower temperature at which the thinner piece is habitually finished, and thence to the smaller opportunity for crystallization.

The question may be resolved into two: (1), is there a special effect of work differing in nature from that of heat-treatment? (2), If not, and if their effects are of the same nature, may not these effects often be produced in a higher degree by work than by heat-treatment?

If this special effect exists and is important, then quality will be benefited by casting very thick ingots and giving abundant reduction: if not, we should cast the metal (1) in ingots as thin, *i. e.* as near the shape of the finished piece as we can without causing excessive casting-defects, (external cracks, pipes, blowholes,) weighing the increased cost of reducing thicker ingots to the finished shape and their greater proportion of crop ends against their greater soundness and cheapness; (2) in ingots of a weight convenient for casting and working, remembering that heavy ingots, demanding powerful cranes and roll-trains, etc., mean costly installation, danger of segregation, difficulty with heating-furnace bottoms (Aiken's crane promises to obviate this); light ingots mean excessive cost per ton for handling in casting-pit, furnace and mill. If the use of high working-temperature,—adopted to save power and to close blowholes effectively,—and of thin ingots, lead to finishing the metal so hot that hurtful crystallization during cooling is feared, cool quickly to V: or, if the best quality is needed, reheat to W (Cf. § 250, p. 179).

[b] Metcalf, Trans. Am. Soc. Civ. Eng., XV., p. 296, 1887.

[c] Holley, Metallurg. Rev., II., p. 381, 1878.

(TO BE CONTINUED.)

Again, if this special effect of work does not exist, or is unimportant, the prospective value and use of steel casting is enormous, enormous the prospective cheapening of steel pieces of castable shape: the gun- the armor-plate- the marine-shaft-question assume a different phase.

While it is conceivable that work should have a special lasting influence, it is not easy to understand what its nature is, that it can survive the complete metamorphoses, not only of crystalline form but actually of mineral species, which heat-treatment causes. It is hard to believe that, when the whole structure of steel has been completely revolutionized by heating to W., it should make any difference whether the supposed special effect had previously been induced or not.

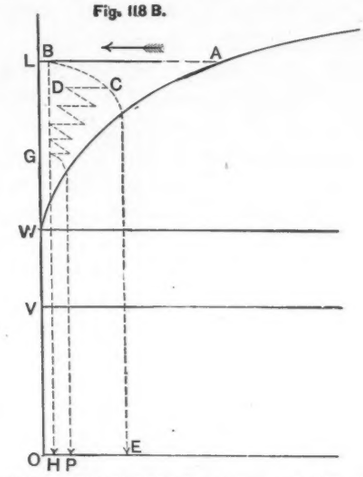
The effect of work surely ceases when the metal melts: I for one find it hard to conceive or believe that the special direct effect of kneading and pressure survives heating to temperatures approaching the melting point. In this view, if this supposed effect exists at all, so that larger ingots yield better finished pieces than smaller sound ingots do, the benefit of each working is still likely to be effaced when the metal is heated again.

Our first question, is the superiority of thin pieces due to lower finishing-temperature or to greater reduction or both, and if to both in what proportion to each, is not easily answered, since the finishing temperature usually sinks as reduction increases. That is to say, if we start with ingot or pile of given size, then the greater the total reduction the lower also will be the finishing temperature. Hence we should expect common practice to answer equivocally, and should look to special cases, in which these two variables do not vary alike, for light. Nor do we look vainly.

To make this question of the finishing-temperature clear, let ordinates in Figure 118 B represent temperature and abscissæ coarseness of grain. Now, the line AW may be taken as representing roughly the size of grain which steel of given composition tends to assume with varying temperature, or the line of maximum coarseness of grain (Cf. Figure 63, p. 178). If the grain be smaller than the maximum for existing temperature it always tends to grow and to approach that maximum. If it be coarser than that maximum it does not tend to shrink back towards the maximum, except when the temperature is *rising* past W. Let us suppose that we cease rolling a piece of steel while its temperature is at L, the mechanical work of the rolls having broken the grain down, and reduced its size to B. During subsequent cooling the grain will grow, somewhat as sketched in the line BCE. If, however, we resume rolling when the grain had reached C, we will again break down the grain, and drive it back to D. And so, keeping on, between passes the grain grows and the temperature simultaneously falls, while at each pass the squeeze which we give the metal breaks up the grain, and the curve of grain and temperature follows the zigzag line BCDG.

If we cease rolling when the temperature has fallen to G, then the grain will grow as the metal cools till the line of the actual size of grain intersects that of the maximum size, the line AW: with further cooling no further growth ensues, and the final size of grain is OP. If we had quenched the metal while at G, the final size of grain would have been OH. If we had ceased rolling when the temperature was at L, the final size of grain in the cooled steel would have been OE. Needless to say, far from pretending that these curves are drawn to scale, I cannot

Fig. 118 B.



The Influence of the Finishing-Temperature on the Size of Grain.

even insist that their general teaching is true: but it certainly seems to harmonize with our phenomena.

If these ideas be true, then the temperature at which rolling or hammering ceases has a most important effect on the size of the grain, and through this on the properties of the metal.

Let us now consider certain cases which throw light on the question as to whether it is the total quantity of reduction which the metal undergoes, or the temperature at which that reduction ceases, *i. e.* the finishing temperature, which chiefly causes the superiority of thin over thick pieces of steel and wrought-iron.

1. If the superiority in question were due to lowered finishing-temperature, and not to increased work, then, since the tendency to crystallize diminishes rapidly with the falling temperature and becomes very faint when V is reached (Figure 61, p. 171), the improvement for given fall of finishing-temperature should diminish as the region covered by this fall is lowered; *i. e.*, the lower the finishing temperature the less should the metal be benefited by lowering it further. If the finishing temperature be already at V, it profits not as regards crystallization to lower it further. Lowering it beyond a certain now-unknown point in turn produces a new different effect, that of cold-working. Now we have seen (§ 296) that the lower the finishing-thickness (and hence the finishing-temperature) the less do thin excel thick pieces, the reduction from 1″ or at least from ¾″ downward often causing no improvement. We reasonably infer that this is because the ¾″ plate was finished at a safe temperature in these cases; the still thinner pieces are no better though they have received more work, simply because their still lower finishing-temperature is of no material advantage. It may indeed be found that the supposed "special effect" diminishes thus with falling temperature: but one would hardly anticipate it, rather expecting exaggerated effects due to cold-working. Nor can the matter be referred to greater closing of blowholes in the early welding-hot passes, for Table 133 indicates that the very earliest reduction, from 6″ to 5″, profits the annealed metal but little: so with the unannealed: whence we suppose that the 5″ piece is finished so hot that it crystallizes

nearly as much as the 6″, while the 4″ piece is finished materially cooler.

2. In case of wrought-iron the improvement continues down to 1″. In Table 136 the only series which runs below 1″, we saw little change between 1¼″ and ⅜″, then a marked increase between ⅜″ and ¼″. A single series gives no safe guidance. The lack of improvement between 1¼″ and ⅜″ may be accidental or normal. If normal, it may be that the 1¼″ is finished at a safe temperature, so that the lower finishing temperatures of the 1⅛″, 1″, ⅞″ and ¾″ bars does not profit them. At ⅝″ cold-working may set in, raising the tensile strength and elastic limit of the ⅝″, ½″, ⅜″ and ¼″ bars. If accidental (perhaps through individual peculiarities, though fortuitious variations in finishing temperature, etc.), it may be that the improvement in wrought-iron continues down to a smaller thickness than in case of ingot-metal, because the working- and hence the finishing-temperature for the former is higher than for the latter, so that a safe finishing-temperature is reached only with thinner bars of the former than of the latter.

3. Further, while in Table 136 the bar-diameter diminishes regularly, the pile-area diminishes only occasionally and by great jumps. Each jump, counteracting the decrease of bar-diameter, should tend to raise the finishing temperature; and, in case of small bars, these jumps actually diminish the improvement which the smaller bar-diameter should give, nay usually turn it into a loss, and this even when the percentage of reduction in the rolls increases.

4. If the superiority of thin pieces were due to the supposed "special effect," one would anticipate that iron previously little worked would receive this special effect more, and be improved more, by reduction than iron previously much worked and in so far saturated with it. If due to finishing temperature, it should be independent of previous work; and in diagrams 1 to 4 of Figure 118A it seems to be: the improvement seems on the whole as great—indeed in elastic limit it is greater—in iron previously much worked as in that previously little worked.

5. In Diagrams 9 to 12, in Figure 118A, the metal on the whole improves slightly as the diameter decreases: the size of pile diminishing almost proportionally to that of bar, the special effect should increase very slightly, and the finishing-temperature decline but little more. These cases give no clear indication as to whether the slight improvement is due to reduction or to finishing-temperature.

6. The United States Test Board believed that the tensile strength and elastic limit of wrought-iron bars tested whole exceeded that of cylinders turned from their middle in a proportion that diminished with the diameter of the bar. This, too, points neither way: for in a thin bar the difference between core and shell, both as to finishing-temperature and amount of work, should be less than in a thick one.

7. What we may provisionally regard as approximately the greatest attainable excellence, since it is, I believe, as yet unsurpassed, has been reached by heat-treatment without forging. Such had Chernoff's famous steel, plotted thus + in Figure 49, page 159.

He cut a coarse-grained, sound, steel ingot into four pieces. One was tested without treatment of any kind: a second was heated to a bright red and hammered till its temperature fell to about W, and then allowed to cool undisturbed: a third was heated to *about*[a] the temperature at which the hammering of the second stopped, and cooled slowly. Their properties are given in Table 141. He says that he has verified his belief that the effects of forging can be produced by heat-treatment, by a whole series of experiments.

TABLE 141.—ANNEALED VS. FORGED STEEL.

		Tensile strength, pounds per square inch.	Elastic limit, pounds per square inch.	Elongation, %.	Reduction of area, %.	Increase of tensile strength, etc., per 100 of that of the ingot, due to treatment. Tensile strength, increase, %.	Elastic limit, increase, %.	Elongation, increase, %.	Reduction of area, increase, %.
Turner, Marshall, Chernoff.	Untreated, direct from ingot..	139,400	.....	2·3					
	Forged.....	166,400	.....	5·3	.....	19·4	.....	130	
	Reheated, without forging ..	155,000	.....	16·6	.....	11·2	.....	622	
	Untreated, direct from casting.	82,400	29,000	4·9	6·6				
	Forged and treated.....	107,240	58,000	13·1	23·1	30·1	100	167	248
	Reheated without forging.....	100,560	46,000	12·1	15·0	22	59	147	127
	Untreated, direct from ingot..	47,070	.....	0·269	0·1				
	Reheated and forged.....	110,800	52,750	3·46	6·3	135	.....	1186	6200
	Reheated without forging.....	73,800	50,550	0·88	3·2	57	.....	227	3100

Chernoff, Revue Universelle, 2d Ser., I., p. 406, 1877.
Marshall, Trans. Am. Soc. Civ. Eng., XV., p. 345, 1887.
Tunner, Jeans, "Steel," p. 662, 1880, from Oest. Zeitschrift. Steel containing 0·8% of carbon, and free from blowholes, was cut into four pieces of like section. One was tested without treatment. Two others were heated in an annealing furnace for fifteen minutes. Of these one was cooled slowly, the other after reaching dull redness was forged till its section was reduced to one twenty-fifth of its original size.

Holley gives an almost equally remarkable instance, an unforged heat-treated cast gun-tube, whose properties are given in Table 142.

TABLE 142.—PROPERTIES OF AN UNFORGED, HEAT-TREATED STEEL GUN TUBE (Maillard, Holley, Metallurg. Rev., II., p. 382).

		1.	2.	3.	4.
Tensile strength.....	Lbs. per sq. in.	101,920	88 704	85,344	86,240
Elastic limit.....	Lbs. per sq. in.	49.280	49,728	50,400	50,840
Elongation.....		11·1	8·7	15·1	15 8

It will be found that these compare favorably with the very best examples in Figures 49 and 50.

We cannot assert confidently that these castings would have been bettered by work, for their properties equal those of the best heat-treated forgings. But we can claim that Marshall's and Tunner's heat-treated castings (Table 141) could have been made much more nearly equal to their forgings by better heat-treatment, in view of their inferiority to Chernoff's and Maillard's.

8. Finally, if bars and plates of given section and thickness made from large ingots or piles were better than those from smaller ones, we could refer their superiority to more effective mechanical action (the first three of our six modes), and little light would be thrown on our present question. But we find these properties independent of ingot- or pile-area. (Tables 137–8.) This argues directly against the existence of the supposed "special effect," and (admitting that the finishing-temperature is approximately constant for given finishing-thickness) in favor of finishing-temperature as the cause of the superiority of thin pieces. Indeed, one would expect the thicker ingot or pile to lead to somewhat lower finishing-temperature, unless this were purposely regulated, and hence to better quality: but this effect we can hardly trace.

To sum up, most of the facts here presented agree well with either view. All agree with the view that the superiority of thin pieces is due to lower-finishing temperature and not to greater reduction: those under 1, 3 and 4 I think agree rather better, and those under 7 decidedly

[a] Chernoff is incorrectly quoted as saying that the third piece was heated to the temperature at which the forging of the second stopped. He merely says that it was heated to "about" that temperature.

better, with this than with the opposite view, to which those under 8 are directly opposed. Cumulatively, then, the evidence raises a presumption in favor of the view that the supposed "special effect" of kneading and pressure as such does not exist, or is relatively unimportant, and that hot-working acts chiefly like heat-treatment in preventing or removing crystallization. But the evidence under 8 is too scanty to be conclusive: and, without an investigation directly aimed to test this theory, we cannot hold it confidently.

Those of us who have held for years as almost an axiom that work directly benefited steel, will not give up their belief readily: I think they will find in the foregoing food for reflection, and reason to doubt but hardly to deny their old faith.

Admitting provisionally that the supposed special effect of work is a myth, and turning to our second question, it seems probable that, to pieces of moderate thickness once freed from cracks and cavities and shaped, we shall learn some day, and indeed soon, to confer a given degree of structural excellence more cheaply by heat-treatment alone than by hot-working alone or jointly by heat-treatment.

But, to give the best results by heat-treatment it now seems necessary to cool quickly to V: this is impossible for the middle of thick solid pieces, so that here heat-treatment alone cannot prevent hurtful crystallization: but for that matter it is hard to see how forging, even hydraulic forging, can either; for the colder outside must to a great extent cut the interior off from foreign pressure before it cools to V. For thick pieces, then, we cannot answer this question as yet.

§ 299. HAMMERING VS. ROLLING.—Clearly these two operations do not act in exactly the same way: the former rather pushes, the latter rather pulls the metal's particles into the desired position.

TABLE 143.—INCREASE OF TENSILE STRENGTH, ETC., ON FORGING AND ROLLING FAGERSTA STEEL FROM 3 × 3 TO ½ × ½ INCH, MEASURED IN PERCENTAGES OF THE TENSILE STRENGTH, ETC., OF THE 3 × 3 BAR. (FROM KIRKALDY' DATA.)

	By hammering.		By rolling.		Ratio of increase by hammering to increase by rolling.	
	Unannealed steel.	Annealed steel.	Unannealed	Annealed.	Unannealed.	Annealed.
Tensile strength..	54·2%	36·2%	52·6%	42·3%	1·03 : 1	0·85 : 1
Elastic limit.....	78·7	47·8	40·3	44·3	1·95 : 1	1·08 : 1
Contraction of area	169·	148·6	115·	120·	1·46 : 1	1·23 : 1

TABLE 144.—ABSOLUTE EXCESS (OR DEFICIT, —) OF THE TENSILE STRENGTH, ETC., OF HAMMERED BESSEMER STEEL BARS OVER THAT OF SIMILAR BUT ROLLED BARS. (Kirkaldy's Fagersta data).

Size, inches square.	Tensile strength, pounds per square inch.			Elastic limit, pounds per square inch.			Elongation, % in 10 inches.			Reduction of area, %.		
	1% C.	0·50% C.	0·15% C.	1% C.	0·50% C.	0·15% C.	1% C.	0·50% C.	0·15% C.	1% C.	0·50% C.	0·15% C.
Unannealed Bars.												
¼	— 4,260	5,230	11,360	15,600	31,500	23,700	— 1·6	— 9·1	—12·1	0	4·0	—13·0
1	— 6,220	— 4,040	10,660	8,300	6,700	17,400	— 0·8	— ·2	—12·4	— 1·8	15·4	— 5·4
1½	— 7,610	— 1,560	150	3,500	6,200	10,200	— 0·5	2·4	—14·3	— 0·8	23·0	2·6
2	—10,460	— 3,153	— 1,360	3,100	6,500	8,700	— 0·3	3·3	1·2	— 0·1	14·7	6·7
2½	— 5,470	6,255	— 525	1,100	— 1,900	8,400	— 0·1	13·2	6·2	— 0·1	15·9	17·4
3	— 5,343	7,687	3,661	1,300	8,400	5,500	— 0·2	— 0·2	— 5·9	— 0·1	0·0	—15·9
Annealed Bars.												
¼	— 5,220	1,910	4,230	4,900	6,600	4,000	— 0·2	— 2·1	—10·5	— 5·0	4·0	— 3·0
1	— 930	— 5,070	1,580	5,300	700	3,100	1·4	3·9	—15·8	— 6·0	14·3	— 3·6
1½	— 6,580	— 4 970	— 1,510	4,900	4,500	2,200	0·1	— 1·5	— 3·6	— 0·3	9·0	1·1
2	— 9,039	— 1,437	— 1,806	4,300	5,200	2,600	— 0·2	0·9	3·5	— 0·3	2·3	5·1
2½	— 2,970	— 5,490	— 870	1,900	— 1,400	4,700	— 0·5	0·9	— 2·9	— 1·1	9·9	7·8
3	— 1,987	9,447	1,360	2,400	2,200	3,700	— 0·3	3·9	— 6·7	— 1·2	3·0	—11·9

Kirkaldy's Fagersta data as condensed in Table 143, at first seem to show that hammering from 3″ × 3″ to ½″ × ½″ raises the elastic limit much more and the contraction of area somewhat more than rolling. But, looking more closely, we note in Table 144 that the advantage which hammering offers is confined chiefly to the reduction from 1″ to ½″, the rolled bars which are from 1″ to 3″ square being as a whole about as good as the hammered if we take into account tensile strength as well as elastic limit: further, that the difference between the rolled and hammered ½″ bars is greatly lessened by annealing. This suggests strongly that the superiority of the hammered bars is due, not to any occult superiority in the action of the hammer, but simply to the fact that the hammer finishes the thin bar at a much lower temperature than the rolls.

In 240 tests on thirty soft steel plates (carbon 0·18%) 1″, ½″ and ¼″ thick, fifteen from slabs hammered and fifteen from similar slabs rolled from the same ingots, J. Riley found that the plates from the hammered slabs were practically identical in quality with those from the rolled ones, excelling them in tensile strength on average by only 2·4%, while in many cases the results were in favor of rolling. They follow:

TABLE 145.—PROPERTIES OF STEEL PLATES FROM ROLLED AND FROM HAMMERED SLABS. J. Riley. (240 tests.)

	Tensile strength, pounds per square inch.	Elongation in 8 inches, %.	Reduction of area %.
Hammered.....	63,280	24·35	42·2
Rolled.....	61,824	24·5	42·5

Journ. Iron and Steel Inst., 1887, I., p. 124 and Sheet III.

In point of fact, it is very doubtful whether, on the whole, hammering in general practice yields a materially different quality from rolling, which is readily understood if the effect of both is chiefly to prevent or obliterate crystallization: their efficiency in this respect depending in large part on finishing-temperature, here the hammer, there the rolls may finish the piece at the better temperature.

Be this as it may, the considerations which in general practice determine the choice between hammer and rolls for ingot-metal are for the most part those of cheapness and ease of working, and not of quality of product, hammering being employed chiefly for pieces which cannot readily be rolled, *e. g.*, those of varying cross-section, such as axles, or of irregular shape, such as crank-shafts: Those which are so large or of which so few of given dimensions are demanded that the preparation of special rolls would not be justified: and bars of tool-steel, these perhaps because the finishing-temperature is more readily controlled in hammering than in rolling. For working red-short or mechanically unsound metal the hammer offers a certain advantage, in that it permits coaxing the material with well-weighted blows, while the reduction in the rolls is usually invariable; and in that unsound spots are easily chipped out by the blows of the hammer itself, while in rolling any needed chipping must be done by hand. In case of weld-metal the sharp blow of the hammer may expel slag more effectually than the more gradual squeeze of the rolls, especially if the piece be rolled alternately in opposite directions (as in reversing and in 3-high mills) since here the slag, instead of being moved ever in the same direction, is squeezed first back, then forth. But these considerations usually count for nothing against the much greater cheapness and rapidity of rolling, and the more accurate section of rolled than of hammered pieces. This is important even in case of intermediate products (blooms): if of accurate section they

can be cut more accurately to weight, and less loss in cropping follows.[a]

§ 300. WELDING.—*Its essential conditions* are adhesiveness and contact, and for both plasticity is usually essential, though under the peculiar conditions of Coffin's weld, § 254, p. 184, it is not. Hence the need of a very high temperature, and in fact one near the melting point is used. As under usual conditions the surfaces inevitably become coated with oxide, to ensure contact this oxide must be made so fluid that it readily squeezes out: hence another need of a high temperature to melt the scale; or if a scale-melting heat cannot be used, of some flux to make with the scale a relatively fusible compound.

But an excessive temperature must be avoided. Why? According to current belief because it entails excessive oxidation. In favor of this view it is pointed out that steel scrap, heated "in a box composed of wrought-iron side and end pieces laid together," is rolled on a commercial scale into well-welded bars.[b] As far as contact is concerned an excessive temperature should be harmless, for a thick layer of scale should be as easily expelled as a thin one: and the higher the temperature the more fluid the scale.

I think that the reason why we must avoid an excessive temperature is that it causes the structural deterioration known as burning: but here we are thrown back on the question "is burning essentially oxidation or structural change," already discussed (§ 263). In this view the wrought-iron box facilitates welding steel scrap not by excluding oxygen (enough will surely enter to coat the steel scrap): but by holding together the scrap (crystalline and friable, or even mushy if very hot), so that it may undergo the squeeze of the rolls, which breaks up the coarse crystallization induced by the excessive temperature. But for this the coarsely crystallized steel would crumble at the first pass.[c]

§ 301. WELDING POWER OF DIFFERENT CLASSES OF IRON.

A. *Ingot- vs. Weld-Iron.*—Apparently competent judges insist that ingot-iron welds as well, as easily, and even under precisely the same conditions as wrought-iron: all of which is as positively denied by others apparently equally competent. A comparison of their printed and of many oral statements indicate:—1, That the conditions most favorable to welding are not the same for these two classes of iron. 2, That the range of conditions which permit excellent welding is narrower in case of ingot- than in that of wrought-iron, so that, 3, in careless hands the latter yields on an average better welds than the former. 4, that this difference diminishes as care and skill increase, so that, under the most favorable conditions and with the greatest skill, each welds practically perfectly, the strength and ductility at the weld practically equalling that of the rest of the piece. 5, That it is practicable to weld ingot-iron on a commercial scale more perfectly than wrought-iron is usually welded. 6, Finally, as the ease and thoroughness of welding of course differ among different varieties of each class, so some varieties of ingot- excel some of wrought-iron in welding power. Some of the evidence follows.[e]

On the one hand several boiler- and ship-builders have assured me that ingot-iron does not weld as well or as easily as wrought-iron: experienced foreign boiler makers and others in some cases hold this view.[d] Results obtained at Berlin appear to be unfavorable to ingot-metal. W. R. Hodge, a boiler-maker for nearly forty years, states that there is still difficulty in welding open-hearth steel. Petersen, of Eschweiler, holds that ingot- cannot compare with wrought-iron in welding-power. (Van Nost. Eng. Mag. XXIII., p. 346, 1880.)[e]

On the other hand, we have many assertions not only that ingot-iron welds well and easily, but even that it welds as well or even better than wrought-iron.

Among the former we have Holley's statement that the Terre Noire steel castings weld readily:[f] Tunner's that ingot-iron welds as well and almost as easily as puddled iron:[g] Martell's that it welds as easily and satisfactorily as wrought-iron:[h] and the description by G. Ratliffe[i] and by A. H. Hill,[j] of excellent welds in steel, which endured trying tests successfully. Among the latter we find that, welding some 8,000 feet of ingot-iron plates every quarter-year, Adamson[k] loses only one plate or so: that Zyromski,[l] Cramps and W. E. Koch[m] state that ingot-iron welds as well, and T. J. Bray[n] that it welds better than wrought-iron: with the last, Tetmajer's results seem to agree.[o] A. Thielen[p] says that about half of his basic open-hearth steel is sold as wrought-iron.

Finally, the results in 3, 4 and 5 of Table 146 prove that ingot-iron may be welded with a surprising perfection, much greater than is usual in case of wrought-iron.

In comparing the strength of welded and unwelded pieces we must remember that imperfect welding is not the sole cause of the inferiority of the welded pieces. The high temperature employed in welding tends to cause coarse crystallization.

[a] Mr. J. B. Pearse advocated the use of hammers for blooming rail-ingots on the ground that rolled steel was more graphitic than hammered, quoting a hammered steel with 1·03% of carbon of which 0·65% was graphitic, against a hammered steel with 0·234% carbon all combined. Even if the former very improbable composition be correct, the two steels are not comparable, nor could we attribute the graphite of the former to hammering much more safely than to its being made on, say, Wednesday, or in proximity to, say, potatoes. To-day we know that rolled rail-steel is not graphitic. (Trans. Am. Inst. Mining Engineers, I., pp. 182, 203).

[b] Holley, Trans. Am. Inst. Mining Engineers, VI., p. 112, 1879.

[c] We need not discuss Weddings' explanation (indeed, it is a definition, not an explanation) that welding represents the change from adhesion to cohesion. It is probably a mixture of both, such as we find in granite. I see no practical importance in the question, for adhesion is now weaker, now stronger than cohesion. Witness the splitting of a bank-bill well glued to two flat surfaces which are then forced apart, the cohesion between the bill's particles being weaker than the adhesion of bill to glue. (Journ. Iron and St. Inst., 1885, I., p. 196.)

[d] Discussion of Stromeyer's paper on "The Working of Steel," Excerpt Proc. Inst. Civ. Eng., LXXXIV., p. 67, 1886.

[e] Metcalf would discriminate between the "interlacing" welding of wrought-iron and the "sticking" welding of ingot-iron, holding that, though ingot-iron may be "stuck" with "wonderful success," when a weld in ingot-iron is parted its surfaces are smoother and with less sign of interlacing than in case of wrought-iron. (Trans. Eng. Soc., W. Penn., 1888, p. 30). Apparently in this view he believes (Trans. Am. Soc. Civ. Eng., XV., p. 301, 1887,) that "steel cannot be welded," while in the wider sense he admits that even tool-steel welds well. (The Treatment of Steel, p. 14, 1884.) The distinction may be fair, but for our present purpose we ask how strong the weld is, rather than how its parted surfaces look.

[f] Priv. Rept. 2d ser., VII., p. 45, 1877.

[g] Journ. Iron and St. Inst., 1880, I., pp. 295–7.

[h] Engineering 1878, p. 414, fr. Trans. Inst. Nav. Arch.

[i] Idem, 1879, II., p. 460.

[j] Trans. Am Inst. Mining Eng., XI., p. 252, 1883.

[k] Discussion of H. Goodall's paper on "Open-hearth Steel for Boiler-making," excerpt Proc. Inst. Civ. Eng., XCII., p. 64, 1888.

[l] Stahl und Eisen, IV., p. 535, 1884.

[m] Trans. Eng. Soc. W. Penn., 1888, pp. 31, 49.

[n] Idem, p. 9.

[o] Iron Age, XXXVI., Nov. 5, p. 5, 1885. This is the inference I draw from his statement that 16·6% of the steel was poorly welded against 23·3% of the wrought-iron.

[p] Jour. Iron and Steel Inst., 1887, II., p. 132.

Of the results in Table 146, those under numbers 1 and 5 deserve especial confidence. Number 4 is given as indicating results obtained in commercial work.

TABLE 146.—STRENGTH OF WELDED SECTION IN PERCENTAGE OF THAT OF THE UNWELDED METAL.

	Wrought-iron, %.	Ingot-iron, %.
1. Chain cables [a]: among 210 lots		
1 had	85+	
21 "	75+ @ 85+	
14 "	70+ @ 75+	
107 "	55 @ 70	
67 " less than	55	
2. A German commission found		
for wrought-iron	81·	
" soft ingot-iron (0·10% C.)	71	
" harder " (0·20% C.)	58	
3. Tests reported by Hupfeld; (S not over ·02%)		
Average	98·7	
Minimum	92·	
4. Experience of J. N. Paxman, maximum	92·45	
minimum	87·00	
5. Bauschinger	91·9	88·

1. a Rept. U. S. Bd. on Testing Iron, Steel, etc., I., p. 203. These results are not very closely comparable with the others. In the records of 210 lots of sections of welded wrought-iron chain cables, the strength of the cable is compared with that of the bars from which it was made. Were the weld perfect, the cable should be about twice as strong as the bar. If we assume that the unwelded portion of the weakest link exerts the full resistance of the bar, then when as in the first line of table the strength of the cable is 1·85 times that of the bar, the strength of the weld may be taken as about 85% of that of the bar. This assumption does not seem strictly accurate: but perhaps accurate enough to afford a rough basis for comparison.

2. Ledebur, Handbuch der Eisenhüttenkunde, p. 641, 1884. Results obtained by a commission of the Verein zur Beförderung des Gewerbfleisses. These are numbers 13 and 14, Table 147.

3. Hupfeld, of Prevali, Mitthell aus dem Mech-Tech. Lab. in München, XIV., p. 32, 1885: Van. Nost. Eng. Mag., XXXI., p. 83, 1884. 22 unwelded and 27 welded bars of common Bessemer ingot-iron were tested tensilely.

4. Discussion of H. Goodall's paper on Open-hearth Steel for Boiler-making, excerpt, Proc. Inst. Civ. Eng., XCII., p. 56, 1888.

5. From (apparently) 12 bars of 12 different sizes or shapes, of best-welding Peine (probably) basic ingot-iron, 12 unwelded and 22 welded pieces were tested tensilely. From (apparently) 7 bars of best Nassau wrought-iron, 7 unwelded and 8 welded pieces of 6 different sizes or shapes were tested tensilely. The welded pieces were in general cut from the same bars as the unwelded ones. The results here given are the averages for each class. Six of the welded ingot-iron bars were stronger than the corresponding unwelded pieces. Bauschinger, Mitthell aus Mech.-Tech. Lab. in München, XIV., p. 31, 1885.

Thus in an experiment of Armstrong's a welded coil, though it did not break through the weld, showed lower tensile strength and elastic limit, and much lower elongation than the untreated metal[a]: and Bauschinger appears to have reached similar results for both ingot and wrought-iron.[b]

Before 1864 E. Riley reported that Bessemer ingot-iron welded, though not very well:[c] before 1866 Galloway welded Bessemer steel shavings.[d] Steel boiler-tubes have been successfully welded for many years, though until lately from carefully selected, costly material: now the welding of pipes of common ingot-iron is carried out on a large scale and successfully. H. J. Bray reports that of this pipe, when butt-welded, the proportion which fails on testing with three hundred pounds hydrostatic pressure is less than 0·5%.[e] Two-foot lengths of two-inch pipe, some of ingot- some of wrought-iron, filled with water and firmly closed at their ends, were exposed to the cold. The iron pipes all burst, the steel ones had their diameter increased one-eighth of an inch, but were otherwise uninjured. Hundreds of furnaces and combustion-chambers for marine boilers have been welded successfully.

The readier welding of wrought-iron is usually and reasonably attributed to the slag which it contains. If but a little of this is squeezed out into the weld during welding, that little, uniting with the oxide of iron formed during heating on the faces to be welded, makes it more fluid, more easily expelled.

B. *Effect of Composition on Welding Power.*—Carbon and sulphur certainly lessen the welding power: the effect of silicon is uncertain: the other elements probably lessen it, but I do not know that we have definite proofs that such quantities of them as are commonly met in a carbon steel are seriously hurtful. Arsenic, antimony and copper are said to oppose welding.

Adamson believes it established that, to ensure good welding, the carbon must be low, the manganese four times as much as the carbon, and the silicon, phosphorus, and sulphur collectively not over 0·10%.[f] While adherence to this formula may favor, I doubt very much if it is essential to thorough welding: note how widely the compositions of many steels in Table 147, reported to weld well, differ from it.

TABLE 147.—COMPOSITION OF WELDING AND OF NON-WELDING STEELS.

		Welding power.		Composition. C.	Li.	Mu	P.	S.
1	H.	Excellent	Pipes	·05	·03	·38	·105	·06
2	K.			·15	tr.	·22	·04	·02
3	"			·14	"	·25	·07	·05
4	"			·14	"	·36	·04	·05
5	"			·18	·03	·58	·04	·02
6	"			·15	·03	·29	·03	·05
7	"			·17	·02	·38	·04	·02
8	"			·14	·03	·72	·06	·04
9	"			·16	·01	·83	·06	·03
10	"	"Not very weldable"		·12	.....	·34	·07	·12
11	"		Boiler fronts	·15	·03	·80	·05	·05
12	"			·14	.....	·60	·06	·07
13	L.	Fair		·20	.....	·20@·30		
14	"	Good		·10	.....	·20		
15	"	Wholly unweldable		·12	·0	·12	·12	·06
16	B.	Excellent		·086	·005	.....	·106	·043
17	"	Poor		·101	·012	.....	·129	·049
18	"	Very bad		·057	·016	.....	·077	·061
19	..	Bad		·21	·017	·38	·112	
20	..	Fair		·11	·023	·20	·093	
21	..	"		·12	·019	·24	·132	

1, Admirably welding Bessemer steel for pipes. A. E. Hunt, discussion of T. J. Bray's paper on "Welding Steel Tubes," Trans. Eng. Soc., W. Penn, p. 32, 1888.

2 to **12,** Steel welded in large quantities, by W. A. Koch, Idem., p. 52.

13–15, Ledebur, Handbuch der Eisenhüttenkunde, p. 639–41. 13, Strength after welding 57·97% of the unwelded metal. 14, Do. do. 70·92% of that of the unwelded metal. 15, Wholly unweldable Bessemer ingot-iron. Cause of lack of welding power unknown.

16–18, Bauschinger, Mitthell. aus Mech.-Tech. Lab. in Munchen., XIV., p. 31, 1885. They are included in number 5 of Table 146.

19–21, Hard and soft open-hearth ingot-irons, tested by the Berlin Commission. They are included in number 2, Table 146. Bauschinger, loc. cit., from Verhand. Vereins Beförderung des Gewerbfleisses, 1883, p. 146.

Sulphur.—Though Adamson cannot weld ingot-iron uniformly when it contains more than 0·02% of sulphur, the data in Table 147 indicate that even as much as ·06 or ·07% permits the successful welding of pipes. Steel with ·12% of sulphur is reported as not very weldable, and with 0·15% as quite unweldable.

Carbon.—It was formerly thought that the presence of a little carbon was indispensable or at least very favorable to welding: but this, I think, is no longer believed. Certain it is that in general the difficulty of welding increases with the proportion of carbon, and the welding power probably practically disappears when the carbon rises above 1·3%. The larger the proportion of other elements present, probably the lower, in general, is the welding power for given percentage of carbon. Thus the welding of apparently common Bessemer steel is said to be hardly possible with 0·20 to 0·35% of carbon, and impracticable with 0·35 to 0·50%:[g] while to the practiced worker the welding of the relatively pure crucible steel is said to be easy with 0·87%, and possible, using the greatest care, with 1·25% of carbon.[h] Though the difference is probably much less than this rather loose wording implies, and though there are welds and welds, it appears to be very marked.

A reason why rising carbon lowers the welding power, is that it lowers the point to which we can heat the metal without danger of burning, but does not lower correspondingly the temperature at which plasticity sets in: indeed, it seems to diminish the plasticity and adhesiveness for given temperature.

Silicon is said by some to injure,[i] by others to improve[j]

[a] Repts. British Assn., 1882, p. 398.

[b] Iron Age, Jan. 7, 1886, p. 13, from Mittheilungen Mech. Tech. Lab., in München, 1885, 12, p. 31.

[c] Percy, "Iron and Steel," p. 7.

[d] Jeans, "Steel," p. 663.

[e] Trans. Eng. Soc. W. Penn., 1888, p. 27–8.

[f] Presidential Address, Jour. Iron and St. Inst., 1887, I., p. 19.

[g] J. Cockerill, Soc., Jour. Iron and St. Inst., 1880, I., p. 318.

[h] H. Leebohm, Sheffield, idem, 1884, II., p. 388. Ledebur, too, puts the welding limit at slightly above 1·2% C.

[i] Ledebur, Handbuch der Eisenhuttenkunde, p. 638. "Silicon doubtless lessens the welding power." Also Peterson, of Eschweiler, Van Nost. Eng. Mag., XXIII., p. 346, 1880.

[j] Kochler, of Bonn, idem: Holley, Priv. Rept., 2d Ser., VII., p. 45: Bohme Jour. Iron and St. Inst., 1884, II., p. 656, from Chem Centralblatt, XV., p. 462, Cf. this work, p. 41.

the welding power: but I doubt if we have any trustworthy evidence. The good welding power of crucible steel, usually rich in silicon, goes to show that silicon is not especially injurious in this respect.

Those who think it beneficial believe that, oxidizing to silica during welding, it yields a flux for the iron-oxide which forms on the surfaces to be welded. It seems to me, however, improbable that the small differences in the silicon content of different steels should have an important direct effect of this kind.

If steel A has 0·50% more silicon than steel B, and if the oxidation of silicon is confined to that layer of metal which is itself oxidized, and if, to fix our ideas, we suppose the iron of that layer to be oxidized to scale-oxide, $Fe_8 O_9$, then the scale which forms on steel A would have only about 0·8% more silica than that formed on steel B, a difference from which one would expect no very important result, either directly or through its causing a corresponding minute quantity of scale-oxide to change to magnetic or even ferrous-oxide. Nor would one expect that the silicon contained in layers of steel beneath those which are themselves oxidized, would be oxidized rapidly, nor, if oxidized, that the infusible microscopic particles of silica would be able to ooze out of the welding surface, and so flux the scale-oxide.

The slag of wrought-iron stands in quite a different position, being, first, fusible and fluid, and second, in relatively large and more or less continuous threads, so that comparatively large quantities of it might be squeezed to the welding surfaces, even from points say half an inch or even an inch back. If the silicon in ingot-metal does favor welding, it may possibly act through difference of potential, or through increasing the metal's plasticity, or changing the composition and hence fusibility of the scale. Manganese is now said to injure,[a] now not to affect the welding power, at least when it does not exceed 1%.[b] The injury attributed to manganese may be due to the carbon, which usually increases with manganese.

Welding unlike irons.—There is a belief that like irons and like steels weld more easily than unlike.[c] Without denying this, my own observations lead me to think it a misleading half-truth. Doubtless wrought-iron welds far more easily to itself than to steel: but it has seemed to me, and many smiths have assured me, that less care and skill are needed to weld steel to wrought-iron than to steel. In welding two classes of iron, A the more, B the less highly carburetted, if they can conveniently be heated separately, either in different furnaces or fires, or in different parts of the same one, each may be (and in practice is) brought to its own welding point, and B being now more plastic and adhesive than A, the conditions seem to favor welding much more than if the hot plastic B were replaced by another piece of relatively cool rigid A. It should be easier to unite a more sticky to a less sticky substance than to unite two less sticky ones.

When, as in case of rail and beam piles, made in part of wrought-iron in part of steel, both classes must be brought to nearly the same temperature, B must be kept down nearly or quite to the low welding heat of A: but even here, since for given temperature B is probably more plastic and adhesive than A, union should be easier than if B were replaced by another piece of A.

In harmony with this view is the not uncommon practice, in welding two pieces of steel, or even in welding steel to the softest basic ingot-iron, of welding a thin piece of wrought-iron between them. The wrought-iron, even at the low welding heat of the steel, is or is thought so much the more adhesive that this double weld seems easier and more thorough than the single weld of steel to steel. In rolling steel-headed, wrought-iron bodied rails, the steel probably welded better to the wrought-iron than it could have to a steel body. But, as it could not weld as well as wrought-iron to wrought-iron, and as the welding was the weak point of wrought-iron rails, there was little reason to expect good results from the steel head.

[a] Ledebur, Handbuch der Eisenhuttenkunde, p. 638. "Silicon doubtless lessens the welding power." Also Peterson, of Eschweiler, Van Nost. Eng. Mag., XXIII., p. 346, 1880.

[b] W. E. Koch, Trans. Eng. Soc. W. Penn., p. 53, 1888. He states, Idem, p. 32, that he has welded steel with from 0·02 to 1·25 of manganese.

[c] Holley seemed to hold this view. (Trans. Am. Inst. Min. Eng.) VI., p. 112.

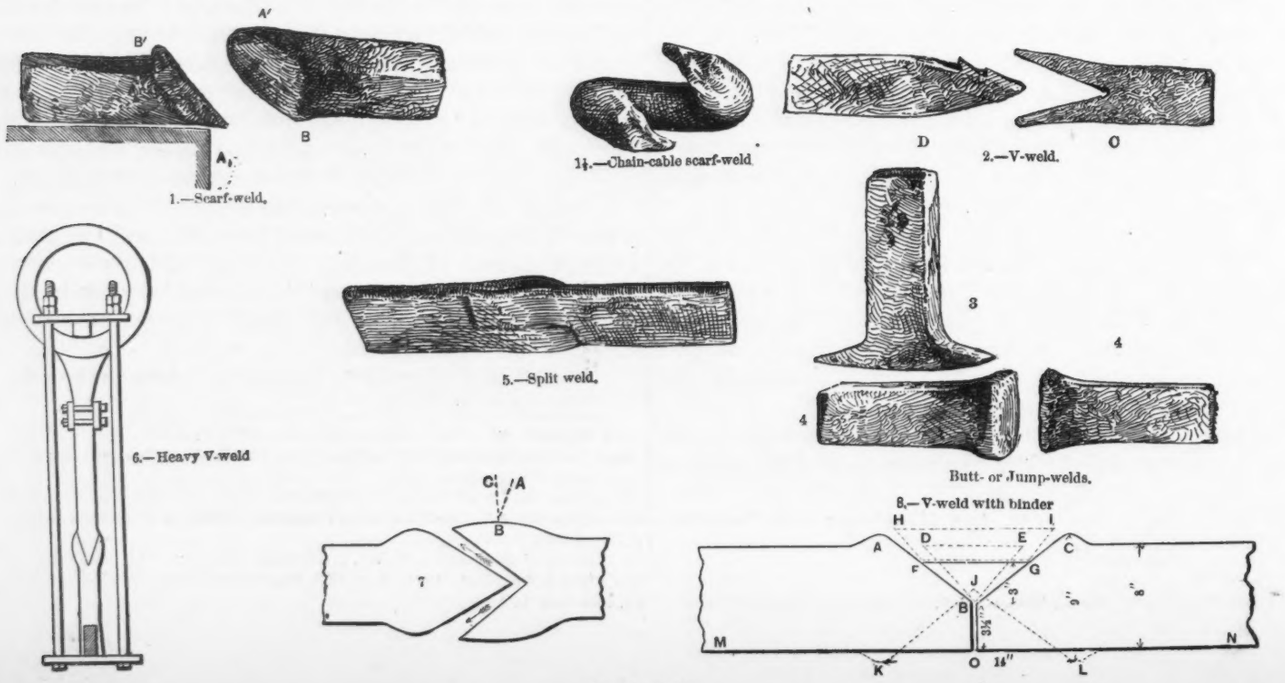


Fig. 119.—Welds.

§ 302. MANNER OF WELDING.—The more common welds are illustrated in Figure 119.

The Scarf-Weld, 1, is perhaps the most common of all for steel, especially for small pieces. In some cases the scarfed faces are riveted together with a single rivet, before welding, to aid alignment during welding. The points A A′ are made narrower than the body of the piece, apparently to lessen the danger of burning and the degree to which the point cools: and also that the point may be the more deeply imbedded into the opposite face B B′ at the first blow, and that the pieces may thus be quickly attached. To compensate for the narrowness of A A′, and also to allow for reduction of section in hammering together, the obtuse parts B B′ must be made considerably wider than the body of the piece.

In making this weld the piece is so held that the thin point A does not at first come in contact with the anvil, which would cool it below the welding heat. The other point A′ is welded to B′ with a few light blows: the piece is then rotated 180°, A is in like manner welded to B, and the whole weld is then hammered together.

The scarf-weld as applied to chain-cables is shown at 1½.

The V-weld 2, 6, is applied oftener to heavy pieces. They are more readily aligned and held in place with this than with the scarf-weld during the welding operation. This weld is sometimes started while the pieces to be welded are in the fire, the male piece being pressed into the female, be it by hand, be it (in case of very heavy pieces) by heavy blows from a sledge or even a battering-ram against one end of one piece: be it by drawing the pieces together with bolts as at 6, Figure 119. But we should regard the adhesion thus given chiefly as an aid to alignment, relying on the subsequent hammering for the strength of the weld.

The scarfing angle, both in the scarf- and V-welds, should be rather acute, as shown at 6, so that the component AB of the welding pressure CB which is at right angles to the welding faces may be great, the pressure thus acting chiefly to force these against and less to slide them past each other.

In welding hard steel to wrought-iron by the V-weld, the steel is always used for the male, the wrought-iron for the female piece, as the latter is exposed to the higher temperature. One face of the male piece is generally notched; the female piece is then heated, the male piece placed within it, and the two hammered lightly together. The sharp edges of the notching on the male piece dig into the hot, soft, female piece, and the two are thus readily held in line: thus lightly adhering, they are now heated to a welding heat and hammered firmly together.

The extreme end of the male piece has a fish-tail shape as shown, so that, when it is driven well home, it may fill the extreme crotch of the female piece at its outer surfaces.

The weld shown at 8 is also known as a V-weld. In this particular case a steel forging eight inches square was welded. It was first shaped according to the solid lines, A, B, O, B, C, and bound together with tie-rods, somewhat as shown at 6. It was then heated to a welding heat, and the V-piece D, E, B, was welded in, being reduced to the shape F, G, B, in welding. Then the "binder" H, F, G, I, was welded in and the points A and C hammered down, the upper surface thus being levelled. The other side was then cut past the point of the first weld and shaped as at K, J, L, and a V-piece and a binder were welded in as on the first side.

The jump- or butt-weld, 3, 4, is used oftener for wrought-iron than for steel.

The split-weld, 5, is a good weld for flat thin pieces of steel, such as carriage springs and carriage tyres, to which, clearly, the V-weld is inapplicable, while the pieces are more readily held in place and aligned with the split than with the scarf-weld.

In general the welding faces, as at 4, should not fit accurately, both that there may be a ready path for the escape of the molten scale, and that only a little surface may be brought together at a time, the force of each blow being thus concentrated on a relatively small extent of welding surface. Thus in the V weld the male piece may be more acute than the female, as indicated at 7, though this makes alignment less easy. For like reason machined faces usually weld less thoroughly than rough-forged ones.

So too the hammering should aim to squeeze the slag out as fully as possible: thus in the V-weld the first blows may be struck opposite the crotch of the female piece, say at B, 7, moving thence to the left, so as to squeeze out the slag in the direction of the arrows.

The pieces to be welded should be so shaped that their thickness across the weld is much greater than that of the finished piece is to be, to allow for reduction in hammering the weld together. The hammering and consequent reduction would have to be considerable, even if the welding itself did not require it, and should be kept up till the temperature has sunk much, so as to prevent the coarse crystallization which sets in during undisturbed exposure to a high temperature. For like reason quick fire and work are recommended, to shorten the exposure to the high temperature: and, because of the metal's tenderness, rather gentle blows should be used, the first ones being mere taps, increasing rapidly in force as the coarse, feebly adhering crystals formed during heating are broken up and their successors hammered into firmer union.

The temperature most suitable for welding is a white heat for wrought-iron; a lower white or a bright yellow for soft ingot-iron; a bright yellow for half-hard and for common tool steels; a moderate yellow for the hardest weldable steels. Unfortunately these terms convey no very accurate idea: and what one calls white, another terms light yellow, etc.

Fluxes.—In all usual cases the welding surfaces inevitably become oxidized during heating: to produce actual contact of metal with metal the oxide thus formed must be removed. To remove it mechanically would be useless, for new oxide would form instantly. It therefore must be made so fluid that it will squeeze out as the plastic surfaces are forced together during welding, contact of metal and metal following that of metal and slag immediately, air being wholly excluded.

Wrought- and soft ingot-iron may be safely heated to a temperature at which the iron oxide itself is fluid: this is true even with rail steel of say 0·35 to 0·15% of carbon. Here flux is not usually necessary, though it may facilitate welding Thus ingot-iron pipes, though demanding a very thorough weld, are welded without flux. If anything, sand is used.

Steel with a higher percentage of carbon cannot be heated to a point at which the oxide itself becomes fluid, without danger of burning: hence a flux must be added to form with the oxide a more fusible compound. The higher the carbon, and the lower consequently the temperature to which the steel can be safely heated, the more fusible must this compound be. Hence, while sand, forming the moderately fusible iron silicates, does well with moderately hard steels; for harder ones, such as tool-steel, borax, which yields the very fusible iron-sodium borate, is used, preferably first melted to expel its water and thus to prevent frothing, and then pulverized. For soft steels, too, borax is sometimes mixed with sand. Ferrocyanide of potassium (yellow prussiate) is liked by some, and is thought to counteract the tendency of the steel to lose carbon during heating.

Beyond these, pulverized clay is used for soft, and numberless nostrums for harder steels. They are mostly alkaline salts, sodium chloride or carbonate, sal ammoniac, etc., and a legion of mixtures, for which the usual ridiculous claims are made. Remembering that the flux cannot benefit the steel itself, and that fluidity and cheapness are probably its sole important qualities, borax and sand leave so little to be desired that they are not likely to be supplanted. Unfortunately, such warnings as these can rarely reach those who need them.

Condensed Instructions.—For tool steel Metcalf[a] recommends a bright yellow heat; and melted and pulverized borax as flux. For ingot-iron Bauschinger advises fluxing with sand; a temperature between redness and whiteness; a quick fire, and quick work:[b] the steam hammer gave much better welds than the hand-hammer. The Steel Company of Scotland recommend a bright yellow heat; if any flux, three parts of sand to one of common salt, moistened; a V-weld, which, with the neighboring parts, is to be lightly hammered during and after welding; and sulphurless coal.[c]

§ 303. Electric Welding.[d]—A. In Thomson's process the pieces to be joined firmly held end to end, aligned, and strongly pressed together by copper clasps, are raised to the welding point by an enormous current of very low potential, which is transmitted to the pieces to be welded by the clamps which hold them, and thus passes through and heats but little of the metal on either side of the joint.

The metal is heated by the resistance which it offers to the passage of the current, quite as a common incandescent burner is, and as the current-strength is under close control and quickly varied, so is the temperature of the metal.

The ends to be united are usually made convex, and, as they soften under the intense heat, the pieces are forced together, and indeed slightly upset. A little borax is added at the joint to liquefy the iron-oxide formed. Sand would be used in welding wrought- or ingot-iron on a large scale.

As the heat developed is proportional to the square of the current strength, *i. e.*, to the ampères—and not proportional to the tension of the current, *i. e.*, to the voltage, very low potential is used, from 0·125 to 6 volts. In

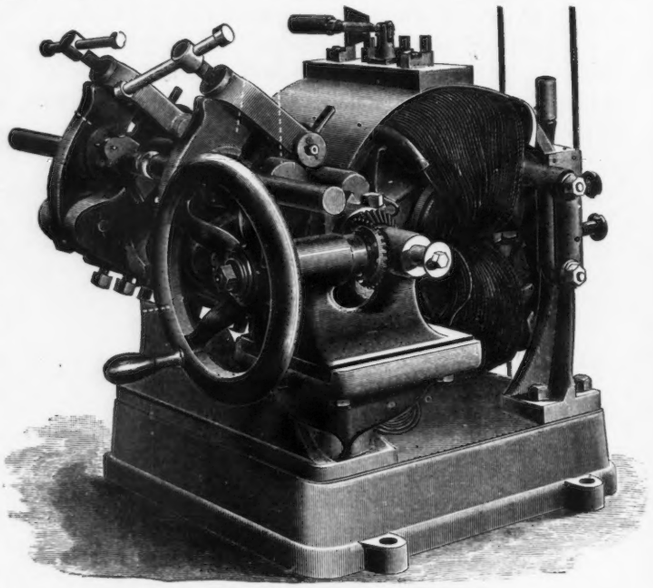


Fig. 121.—Elihu Thomson's Electric-welding Machine.

general the smaller the sectional area of the piece the higher the volts used. Electricity of this low potential is, of course, perfectly harmless to the human body: indeed but a trifling current at such potential would pass through so poor a conductor.

The current (ampères) needed increases with the sectional area of the piece to be welded. As we proceed from very small wires the current needed at first increases a little more rapidly than the sectional area, say with the $2^{\cdot 3}$th power of the diameter. But as the sectional area increases the rate of increase of needed current diminishes, so that in passing from 1″ to 2″ bars the current needed apparently increases less rapidly than the sectional area.

The horse power needed is roughly proportional to the current, and of course increases not only with the sectional area but with the rapidity of heating desired. Thus it is estimated that a 1″ round bar can be welded with 12 horse power, but slowly: to weld it in from 25 to 30 seconds 18 to 20 H. P. should be provided. To weld a 2″ round bar in one minute about 40 H. P. are needed, and say 20,000 ampères.

The preceding data must be taken as very rough approximations to the truth, in view of the paucity of experimental data available and of the many variables.

For given sectional area iron needs much less current to reach given temperature than copper, owing to its lower conductivity both for electricity and heat, its low thermal conductivity preventing the rapid conduction of heat from the intentionally heated parts.

As the resistance increases with the temperature, so while the joint is forming its several parts tend ever to uniform temperature; for, if the temperature be uneven, an undue share of the current passes through the cooler and less resisting parts, and thus their heating is hastened while that of the hotter parts is retarded.

Though it is only within a few months that the process has actually reached a commercial stage, some fifteen or

[a] The Treatment of Steel, p. 14, 1884.

[b] Mittheil. aus Mech.-Tech. Lab. in München, XIV., pp. 34-5, 1885: also Iron Age, Jan. 7, p. 13, 1886.

[c] Journ. Iron and St. Inst., 1881, I., p. 229.

[d] H. D. Hibbard, Trans. Eng. Soc. W. Penn., p. 25, 1889: C. J. H. Woodbury, Trans. Am. Soc. Mech. Eng., X., 1889, to appear: Eng. Min. Jl., XLVII., p. 136, 1889: Engineering, XLVII., p. 571, 1889. Proc. Soc. Arts, Mass. Inst. Technology. p. 35, 1886-7: Journ. Franklin Inst., XCIII., p. 357, 1887. This section is based chiefly on information given me by the Thomson Electric Welding Company, April 3d, 1889.

(TO BE CONTINUED.)

twenty electric welding machines have already been sent to licensees, for regular use in manufacturing and similar establishments.

The largest sectional area yet welded is that of 2·5″ iron bars, but a larger machine is now building for welding the four-inch-square irons of locomotive frames.

Among the more important uses so far developed are the welding of telegraph wires end to end, especially in installing lines, a portable storage battery being used: welding lead pipes end to end: welding iron-pipes end to end, and so making very tight joints (welding the *seams* of pipes is not yet done); welding brass to iron in pump piston-rods: welding and assembling the drop-forgings, etc., of carriage work. I understand that all these operations are now carried out on a commercial scale.

The links of chains are also welded with success, but not yet commercially, as the chain-making machine is not perfected. The links are welded by preference with double welds, one in each of the long sides of the link: links thus welded do not break through the weld, but through the shoulder. The faces to be welded are in this case plane, instead of convex, as in most other cases.

Links can also be welded with a single weld, just as in common chain-welding practice. It might at first be thought that the electricity would pass chiefly through the solid body of the link, as offering the largest sectional area, rather than through the smaller section of the contact between the faces to be welded. But these faces are made flat, and so give broad contact, and moreover the electricity is purposely introduced very close to the faces to be welded, so that the path through them is very much shorter than that around through the solid part of the link: and it actually happens that most of the heat is localized closely at the weld. So in welding locomotive-frames.

Of the many other uses of this interesting process, I need only mention the welding of wire-ropes; an application for a patent for this is now pending.

The strength of the welds, as indicated by the data in Table 148, compares well with that of hand-welds as given in Table 146. In the latter Bauschinger, whose results command implicit confidence, found that wrought-iron lost less than 10% in hand welding, and that ingot-iron lost 12%. With wrought-iron and soft-steel, numbers I., II., IV., V. and VI. of Table 148, the strength of the welded bars is in general very high: in number II., however, there is a very heavy loss of strength in welding. Moreover, in other tests applied to the material used in I., the sectional area at the weld was much greater than in the rest of the bar: nevertheless the bar broke at the weld.

The hard steel, III., lost strength very heavily in welding.

The inference seems to be that admirable welds, equalling if not excelling hand-welds, can be obtained by this process: but that with the degree of skill as represented by the results in Table 148 (especially if we assume that these were obtained from picked welds), the welding is much less certain than hand-welding. As the conditions seem under closer control, one expects that, with experience, as good and more certain welding will be made with this process than by hand.

TABLE 148.—STRENGTH OF ELECTRICALLY-WELDED JOINTS.

No.	Material.	Sectional area. At weld sq. in.	Sectional area. Of bar sq. in.	Position of fracture of welded bar.	Tensile strength. Average of unwelded bar, lbs. per sq. in.	Tensile strength. Of welded bar in percentage of that of unwelded bar. Maximum.	Minimum.	Average.
I.	Wrought-iron, not welded..	.....	·408	.....	54,363			
	The same, welded.....	·408	·408	At weld		94·77	90·60	92·69
II.	Wrought-iron, not welded..	.....	·196	.....	58,163			
	The same, welded.....	·198±	·196	At weld.		87·55	67·45	77·50
III.	Octagonal steel, not welded.	.....	·360	.....	127,040			
	The same, welded.....	·366±	·360	At weld.		60 13	50 07	55.10
IV.	Steel ..... not welded.	.....	·198	.....	75,450			
	Steel ..... welded.....	·198±	·197±	At or near weld.		101·88	99·17	100·50
V.	Steel..... not welded.	.....	·302	.....	64,980			
	Steel..... welded.....	·302	·302	At weld.		.....	.....	97·00
VI.	Wrought-iron not welded.	.....	·312	.....	52,440			
	Wrought-iron welded.....	·312	·312	At or near weld.		99 50	98·76	99·13

These results were obtained with the United States testing-machine at Watertown, Mass., in charge of Mr. J. E. Howard. I here give only the results obtained with pieces in which the sectional area at the weld was the same as in the rest of the bar: other cases are less readily comparable.

Electric welding is at a disadvantage in that the metal is exposed to a very high temperature without receiving the work as it cools which it undergoes in hand-welding, and which removes much of the coarse crystallization which arises at the high temperature. In Thomson's process the welded piece is not forged: but it seems to me that it would be very desirable, at least in case of important pieces, to hammer the weld. This would increase the expense considerably, but without it the coarse crystallization set up around the weld will remain a source of weakness, or at least of brittleness.

The advantages claimed for the process are that the alignment is easy and accurate: the welding is extremely rapid: the parts to be welded are visible during heating and their temperature is thus under better control, so that less skillful and hence less costly labor may be used than in hand-welding: and the heat is closely localized, so that less energy is needed and that there is less oxidation and loss of iron than in hand-welding. One might add that the power for generating the electricity may be obtained by burning sulphurous and hence often much cheaper fuel than can be used in hand-welding.

Clearly, as different classes of machines, different current and potential, are needed for different conditions, the process is not applicable to the work of the common jobbing smith, nor to the forges of most establishments, where all kinds of welds are to be made on pieces of all sizes and shapes. But I am confident that the process will find very valuable and somewhat varied fields in establishments in which there is an abundance of work of certain tolerably uniform kinds, so that the welding plant and skilled workmen may be kept occupied. Central jobbing establishments in large manufacturing centres, too, should eventually be profitable.

Important uses in welding cast-iron, and in heating, welding and brazing the other metals, lie beyond the field of this treatise.

B. *In Bernardos' process*[a] an electric arc melts, between

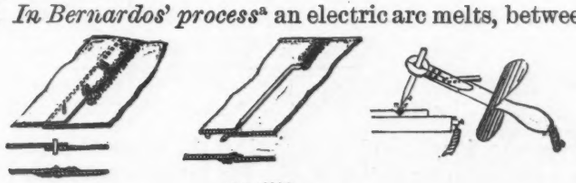


Fig. 121A.

the pieces to be united, chips, etc., of the material of which these pieces are composed. It is therefore a soldering:

[a] Engineering, XLV., p. 173, 1888. Zeit. Vereins. Deut. Ing., XXXI., p. 863, 1887. Scientific Am. Supp., No. 635, p. 10,144, Mch. 3, 1888.

but this is not, as some would persuade us, a fault. The pieces to be welded are made the negative pole, the positive pole being a carbon pencil. Were this arrangement reversed the metal would be oxidized rapidly. As it is, the carbon wastes rapidly, but is of course readily replaced. It is held in a scissor-like tool as shown in Figure 121 A, with a wooden handle through which the flexible electric cable passes, and a screen to further protect the workman's already stoutly gloved hand, his eyes and face being guarded by a dark glass.

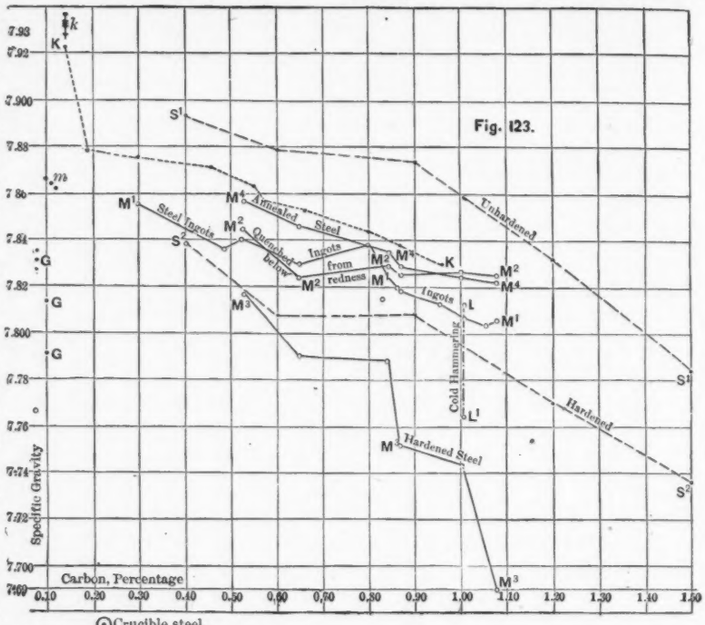
In joining plates the edges may be feathered as shown and the furrow filled with iron turnings, which are melted by the arc, fresh turnings being then supplied till the furrow is filled. In joining bars end to end one is centred in a lathe which is connected with the negative pole: the other is pressed against the first and stuck lightly to it with a few touches of the carbon: the lathe then revolves slowly, and iron is added to the joint little by little. Wires are joined by slipping a ring over their hooked ends, and melting the whole to a button.

As compared with Thomson's this process is at a very serious disadvantage in lacking ready control over the temperature, and in the much higher temperature developed, with consequent greater tendency to crystallization in cooling, liability to burn and blister adjacent parts, etc. It is stated that the results of tests furnished by Bernardos indicate a serious loss of tensile strength: the loss of ductility, especially under shock, should be still greater. Subsequent forging may remedy this in certain cases.

It seems less fitted than Thomson's for joining bars and pipes end to end: and, at least at first sight, less fitted for joining wires than Thomson's: in short less desirable than Thomson's where the sectional area to be joined is small. But for joining the edges of large thick plates, for patching thick plates, etc., in short where the sectional area is so very large that it would be extremely difficult to heat it all simultaneously, Bernardos' system seems at first sight to have an advantage. But unless, as here seems improbable, the crystallizing at the weld can be overcome, it will be better to rivet the edges of plates than to weld them by this system. Its future seems less promising than that of Thomson's process, though it is still too early to pronounce judgment with complete confidence.

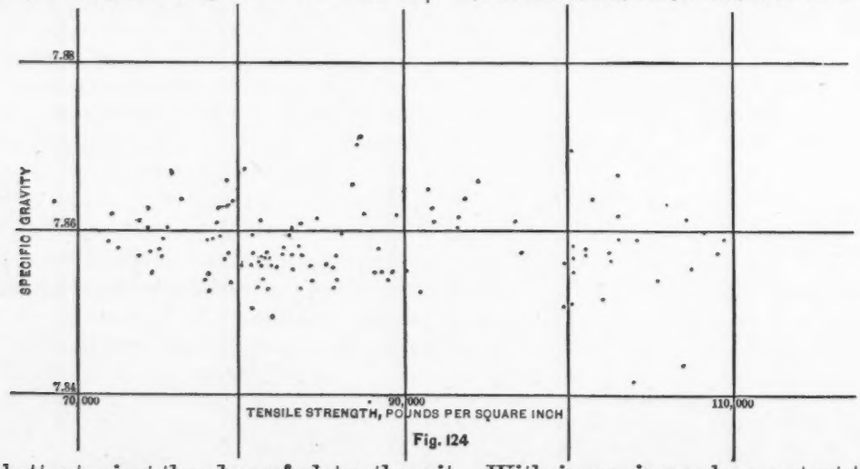
Bernardos' process is said to have been adopted at the works of Messrs. Struve in Russia: it has not, I believe, been introduced into this country.

§ 304.—THE DENSITY OF STEEL,[a] so far as my observation goes, lies with rare exceptions between the limits sp. gr. 7·6 and 8, that of annealed steel usually lying between 7·82 and 7·87 sp. gr. The sp. gr. of wrought-iron is reported in certain cases as only 7·52. The density is lowered by quenching and by cold-working, but returns almost or quite completely to its initial value when the cold-worked or quenched steel is heated to redness and cooled slowly. Hot-working when above W probably does not affect it, when slightly below W probably raises it. With increasing carbon-content the density probably decreases slightly.



⊙ Crucible steel.
• Bessemer steel and unknown.
▽ Open-hearth steel.

LL_1, steel of about 1% of carbon. L annealed and L^1 hammered cold. Langley, Metcalf, The Treatment of Steel, p. 37 et seq., 1884. M, of twelve crucible steel ingots, M^1, six were hammered and rolled to bars 0·625" in diameter. One end of each was heated to whiteness, the temperature decreasing gradually towards the other end. They were then quenched in water. M^2 gives the density of the part which was slightly below visible redness when quenched, M^3 that of the part which was at white-hot when quenched, and M^4 that of this last after subsequent slow cooling from a high yellow heat. Idem.
K, Koppmeyer, forged Bessemer steel, Dingler's Journal, CCXI., p. 22.
S^1, S^2 Sandviken Bessemer steel. "Metallurgy," Crookes and Röhrig, II., p. 13.
K, W. Kent, Trans. Am. Inst. Mining Engineers, XIV., p. 585, 1886.
M, G. S. Miller, Idem, p. 583, Bessemer steel.
G, F. L. Garrison, Idem, XV., p. 90, 1887, Bessemer steel.



[a] Pure iron, 7·85-7·88: steel, 7·60 to 7·80, Landolt und Börnstein, Phys.-Chem. Tabellen, 1883, p. 78.
Clark's "Constants of Nature," I., p. 13, 1873, gives the sp. gr. of iron as from 6·03 (iron by hydrogen, Stahlschmidt) and 7·130 (reduced by carbon, Playfair and Joule), to 8·007, and 8·1393 (the last electrolytic).

TABLE 149. SPECIFIC GRAVITY OF STEEL.

No.	Authority.	Description.	Sp. Gr.
1	.....	Usual limits, unhardened steel	7·85 to 7·87
2	.....	Extreme "	7·6 to 8·
3	Rinman.	Unhardened blister steel, 2 pieces	7·751 and 7·991
4	"	same pieces hardened	7·553 and 7 708
5	Caron.	Unhardened steel	7·817
6	"	the same hardened 30 times	7·743
10	Elsner.	Cast-steel	8·0923
11	"	the same hardened	7·7647
14	Wrightson.	Wrought iron	7·6400
15	"	the same quenched 50 times	7·5520
16	"	" " " 100 "	7·5200
17	"	" " " 125 "	7·5260
18	Kent.	Soft ingot-iron, carbon 0·14	7·9275 to 7·9356
19	Miller.	" " " 0·10 to 0·12	7·800 to 7·866
20	Garrison.	" " " 0·08 to 0·10	7·758 to 7·886
21	Holley.	Annealed casting	7·900
22	Kohlman.	Bessemer steel ingot	7·500
23	"	bloom from 22	7·760
24	"	rail from 23	7·710
25	Henry.	Wootz	7·727
26	Pearson.	"	7·181@ / 7·647
27	"	" hardened	7·166

3 to **4**, Percy, Iron and Steel, p. 849, fr. Geschichte des Eisens, 1785, p. 134.
5 to **6**, Comptes Rendus, LVI , p. 211, 1863.
7 to **9**, Cf. Note to Figure 123.
10, **11**, Idem, fr. Jou'n für Prakt. Chem., 1840, XX., p. 110.
14 to **17**, T. Wrightson, Journ. Iron and St. Inst., 1879, II., p. 425.
18 to **20**, Cf. Note to Figure 123.
21, Holley, Priv. Rept., 2d. Ser., VII., p. 41, 1877. Annealed Terre Noire steel castings.
22 to **24**, Kohlman, Engineering, 1881, p. 125.
25 to **27**, Percy, Iron and Steel, pp. 775-6, 1864.

The effect of cold-working is shown by line LL in Figure 123, where repeated cold-hammering lowers the specific gravity by 0·047: we have seen in § 270 a loss of 0·040 on punching and 0·047 on wire-drawing.

The lightening effect of quenching increases with the suddenness of the cooling, the quenching-temperature, and the proportion of carbon in the steel: thus Langley found that, under like conditions, quenching from whiteness lowered the specific gravity of steel with 0·529% of carbon by 0·026, that of steel with 1·079% of carbon by 0·135.

Quenching from even as low a temperature as 212° F. appears to lower the density slightly: in four cases Langley found that the specific gravity fell by from 0·011 to 0·027.

Repeated quenchings lower the density cumulatively, but at a gradually diminishing rate. Thus Wrightson found that on fifty heatings and quenchings the specific gravity of wrought-iron fell from 7·64 to 7·552: after fifty more heatings and quenchings it had fallen still farther to 7·52, the total loss being 0·120. But after twenty-five additional quenchings it had risen slightly, by 0·006 (to 7·526).

Caron found that thirty quenchings reduced the density of steel by ·074. Much greater losses are reported, so great indeed that one hesitates to accept them. Such are 3 and 4 of Table 149.

The rapid divergence of lines $M^1\ M^1$ and $M^2\ M^2$ from line $M^3\ M^3$ in Figure 12, the first representing steel ingots, the second bars forged from them and quenched from below redness, the last like bars quenched from scintillating whiteness, indicates that the effect of quenching is much greater in high- than in low-carbon steel: but this relation is not well marked in lines $S^1\ S^1$ and $S^2\ S^2$ of which the first represents unhardened, the second hardened Bessemer steel. But though the difference between the density of high- and that of low-carbon steel depends greatly upon the conditions of cooling, it is probable, to judge from the general direction of lines $M^4\ M^4$ and $S^1\ S^1$ and K K in Figure 123, that even in well annealed metal the density decreases slightly with rising carbon-content, probably at about the rate of 0·06 per 1% increase of carbon-content. This indicates that cementite is lighter than ferrite.

That hot-forging above W does not materially increase the density we infer from the fact that slowly cooled bars do not appear to be materially denser than the ingots from which they are forged. Indeed, the density of unforged castings is surprisingly high. Thus, Holley reported the specific gravities of annealed Terre Noire castings as 7·9, a point rarely reached by forged steel: Mr. T. T. Morrell found the specific gravity of a rail ingot 7·8464.[a] Figure 124, representing many commercial steels examined by the United States Board on testing iron, steel, etc., shows that the sp. gr. usually lies between 7·85 and 7·87. In Figure 123 a comparison of lines $M^1\ M^1$ and $M^4\ M^4$ shows that the steel ingots here represented are nearly as dense as the bars forged from them and slowly cooled from a light yellow heat, after previous quenching from whiteness. Broling found that the specific gravity of a button made by melting bar-iron was 7·8439: Percy found that of a button from iron wire to be 7·8707: hammering and cold-rolling reduced it to 7·865.[b]

Chernoff reported that hot-working at a temperature below W increased the density, sometimes to 8. The rolling of rails made from reheated blooms ceases while they are at about W, a low yellow heat: that of rails rolled direct from the ingot without reheating, at a little above V, say a dull red. The density of the latter is said to be about 1 to 1·5% higher than that of the former, which would make their specific gravity from about ·0785 to ·117 higher, or about 7·93. This is inferred from the apparently excessive weight of direct-rolled rails of given section: but I know of no direct determinations.

§ 305. DILATATION. THE FLOATING OF COLD IRON.—It were beyond the scope of this treatise to consider the dilatation of iron exhaustively. (See Table 109, § 273, p. 218.) I will confine myself to two points. First, late investigations at the Watertown Arsenal show that the coefficient of dilatation in like steels diminishes as the proportion of carbon increases.[c] This raises a new difficulty in the way of the tension or stress theory of the hardening of steel, since the high-carbon steel which hardens intensely contracts less on quenching than non-hardening low-carbon material. Quenching from bright redness increased the coefficient of expansion greatly, especially in case of highly carburetted steels.

The floating of solid on molten iron is clearly due to the simplest of possible reasons, to wit, that the solid iron is lighter than the molten iron. Wrightson[d] has shown this in two ways. First by means of his autographic "oncosimeter," he measured the force with which balls of cast-iron immersed in molten cast-iron sought to rise or fall, obtaining diagrams like that in Figure 125. He found that, when first immersed, the tendency of the ball was downward: this downward tendency quickly gave way to an upward tendency, which, as the ball grew hotter, gradually reached a maximum, then declined slightly till, at the point of fusion, it suddenly fell to zero.

Reversing, he measured the diameter of a 15·28″ cast-iron ball during cooling, beginning two minutes after casting it in a sand mould. During the first 24 minutes

[a] Private communication, Feb. 20, 1889.
[b] Percy, Iron and Steel, p. 1.
[c] Jas. E. Howard, private communications, Feb. 8th, 20th, 1889.
[d] Journ. Iron and Steel Inst., 1879, II., p. 418: 1880, I., p. 11.

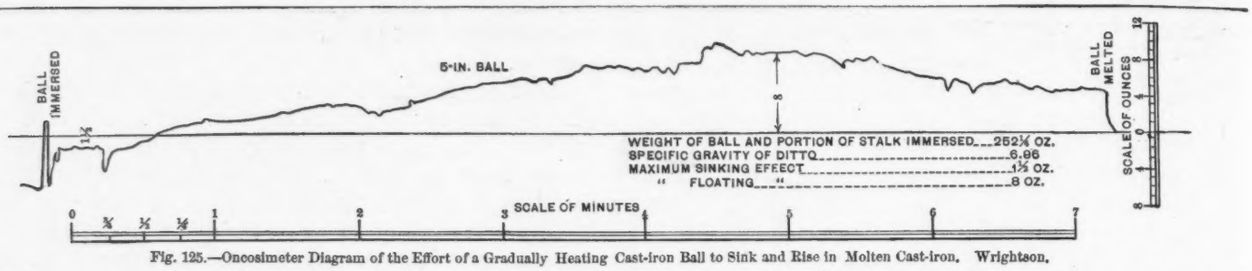

BALL IMMERSED
5-IN. BALL
BALL MELTED
SCALE OF OUNCES
WEIGHT OF BALL AND PORTION OF STALK IMMERSED 252¼ OZ.
SPECIFIC GRAVITY OF DITTO 6.96
MAXIMUM SINKING EFFECT 1⅛ OZ.
" FLOATING " 8 OZ.
SCALE OF MINUTES

Fig. 125.—Oncosimeter Diagram of the Effort of a Gradually Heating Cast-iron Ball to Sink and Rise in Molten Cast-iron. Wrightson.

the ball expanded 0·078″ in diameter, then remained stationary for 3 h. 13 m., then contracted for more than 4 h. 30 m., the total contraction from the maximum diameter being 0·18″.

Thus in both cases the maximum volume (or minimum density) occurs decidedly below the melting point, so that both solid iron in melting, and molten iron in solidifying and further cooling, first expand to a maximum volume, then again contract.

Moreover, while the cold iron is denser than the molten,

TABLE 150.—COMPOSITION OF STEEL.

SEE FURTHER pp. 18 to 20: 38, guns and rails: 40, silicon steel: 48, manganese steel: 53-4, rail steel: 69, phosphoric steel: 71, phosphoric steel: 74, 78, chrome steel: 81, Tungsten steel: 83, cupriferous steels: 92, oxygen: 162, castings.

	C.	Si.	Mn.	P.	S.
Anchors, cast	·58	·186	·65	·06	·06
Armor-plate, face	·75	·18	1·45	·06	·05
" " protective deck	·23	·02	·48	·07	·05
Augur bit	·65		·73		
Axe "overcoat"	·95	·081	·38	·023	·018
" "	1·08	·096	·38	·046	·032
Axles, carriage	·10 to ·35				
" crank	1·05				
" light	·16		·75–·80	·10	
	·15	< ·015	·75–·80	·105	
	·16		·78–·80	·102	
" railway	·46–·52		1·11 to ·83		·04 or ·10
" "	·15	·012	·60	·07	·046
Beams, tees, angles	·18 to ·21		·60 to ·80	as high as ·07	as high as ·06
Boiler-plate	·14	·035	·47	·047	·061
"	·09	·02 to ·03	·3	·07	
"	·16		·25	·069	
"	·16		·75	·066	
"	·16	·014	·52	·047	·05
"		02 to 05	·30 to ·40		
"	·09	·02 to ·03	·30	·07	
	·15		·03	·05	·03
Boulat	3				
Chisels	1·00				
" chipping	·75				
" "	·75		·39		
Cutlery, Bessemer	·5 to ·6		·1 to 1·1	·05	·06
Die for iron pipes	1·09	1·38	·36		
Drill, rock	·98		·21		
" "	1·06		·29		
Drop-forgings, complex, Pistol-stocks		·005			
Drop-forgings, complex, Wrenches	·09 to ·14	·015 rare	·35 to ·65	·04	·04
		·02			
" " less complex, *e. g.* pistol-barrels	·14 to ·18	·02±	·5 to ·6	·04	·06
Eye-bars	·13 to ·16			·03 to ·06	
" "	0·32	0·02	·60	·034	·045
File, saw	1·37				
" " mill	1·15	·25	·20	·05	·025
" " 14″ round	1·42	·251	·52	·033	·009
" " 10″ square	1·48	·186	·17	·032	·013
" " 12″ half round	1·43	·270	·52	·032	·014
Fish-plates	·14	·014	·54	·11	·09
Forgings	not over ·30				
" heavy	·2 to ·3			·04 to ·09	
Guns—English	·25 to ·5		·8 to ·08		
Guns—French	more C.				
Guns—Spanish	·23 to ·33	·05 to ·06	·32 to ·38	·005 to ·007	tr.
" barrels	·25	·234	·036	·022	tr.
" " Swedish	·35 to ·45	·25 to ·40	·40 to ·60	·06 or less	0
" Krupp	1·18	·33	tr.	·02	·03
	·50	·11	·16	·04	
	·338		·075		
" tubes, Woolwich	·40		·126		
	·300		·312		
	·417		·240		
" " "	·240		·216		
	·272		·225		
" " "	·143		·341		
	·194		·248		
Harrow-disc, rail-stock	·85				
Knife-section	·95 to ·108		·20		
Lawn-mower knife	·88		·32		
Machinery steel, common	·28	·02	·60	·10	
Mower-knife	·98 to 1·24	·326	·18	·051	·034
Nails	08 to ·12	·01	·4	·08 to ·09	·06 to ·076
"	·10	·02	·14	·027	
	·15				
Nail-plate	·10 to ·12	·01 or less	·40	·10±	below ·10
	08 to ·10	·009 to ·01	·35 to ·40	·10 to ·12	·045 to·055
"	·07	·016	·66	·08	·12
Piston-rods, heavy	·15		·8	·05	·05
" steam-hammer	·12 to ·15				
Plough-beam	·3 to ·35				
Projectiles, Terre Noire	·45 to ·60	·25 to ·30	·50 to ·60		
" Whitworth *a*	·80	·06	·43		
Projectiles, Krupp	·55	·235	·321	·027	·008
" Hotchkiss	·55	·053	·510	·054	·035
			·054		
Punch for fish-plates *h*	1·04				
Rails, excellent		·11	1·20	·10	
" Dudley's formula	·25 to ·35	not over ·04	·30 to ·40	not over ·10	
" Bethlehem have sometimes been held below				·06	
" some late best American, special order	·50 to ·55	·125	·100 to ·115	·075 to ·090	·07
" now have up to	·60				
" cupriferous	·33 to ·48	·03 to ·08	1·05 to 1·25	Cu ·51 to ·66 P ·07	·08 to ·10
" Bethlehem	·40	·10	·80 to ·90		·05 to ·08
" bad U. S. *e*	34 to ·49	·02 to ·07	1·11 to 1·63	·105 to ·147	·021 to ·097
" welsh steel rails, bad *f*	·20	·10 (?)	·547	·20 to ·26	·075
" average of one month at an American mill				·165	
Razors	1·5				
Rifle barrels	·22		·35 to ·45 *d*		
" and shot-gun barrels	·20 to ·24	·01 to ·02	6 to 7	·04 to ·05	·05
Rolls	·60	·20±			
" Krupp's	·852	·13	·448	·04	0
	1·020	·195	·425	·05	·005
" 10″ roughing	·40	·02	·60	·10	·06
Saws, good U. S	·93	·29	·81	·026	
" Jessop's best	·90 to 1·16	·194 to ·36	·14 to ·45	·024 to 030	
" U. S., very good	1·20	·26	·18	·033	
Screw-wire	·10 to ·12		·40	·11 to ·12 *g*	·09 to ·12
Screen-plate for stamp-mill	1·11	·293	·17	·069	
Screw-driver	·86		·72		
Sett	·87				
Shafts, marine	·30	·18	·57	·088	·042
" " cast	·16	·03	·882	·05	·05
" heavy, forged, Bessemer	·20 to ·30				
Shafting (small)	·17 to ·20	·02±	·5 to ·8	·09	·07
Ship-plate, *b* British	·17	·04	·70 to ·80	·06	·06
Shovel	·08 to .50				
"	·43				
Spectacle bows	1·04		·41		
Springs, Bessemer steel, one mill	·45 to 1·00	0·12	1·to 1·25±	·04 to ·05	·04 to ·06
Springs, bed	·53		·72		
" furniture	·40	·12	·90	·09	·10
" British	·55	·05	·8	·06	·06
" clock	·87		·34		
" open-hearth	·8	·08	·60	·075	·05
" truck	·60		·40		
" washing-machine	1·05	·148	·26	·037	·014
Structural steel	·25	·06	·50		
Upper limit of phosphorus for bridge-members. Usual				<	·08
Upper limit of phosphorus for bridge-members. The most prudent engineers specify				<	·05
Taps for nuts *i*	1·08				
Taps and dies	1·12				
Tin-plate	·10 to ·15		·216 to ·30	·04	·04
Tool-steel, Fagersta	·7	·03	·26	·025	
" " Midvale	1·00	·10	·27	·027	
" " French	1·00	·06	·08	·02	·015
Tool, German	·92	·09	·12	·02	·005
" mason's	·60				
Tyres, carriage	·35				
" Krupp	1·09	·26	·52	·11	·05
" locomotive	0·55				
" R. R	·22 to ·60		·72	·05	·05
" R. R. American *c*	·62 to ·78		·80 to 1·00	< ·055	
" " British	·35 to ·55				
" "	·32	·04	0·8	·05	·068
Welding steel	·07	·01 or less	·15 to ·30		
Wire—Bessemer	·04 to ·12	·04	·50	·096	·04 to ·05
" soft Swedish		·031	0·399	·034	·006
" occasionally up to					·15
"	·12	under ·015	·65 to ·70	·10	
" very strong	·828	·143	·587	0	·009
" fencing	12 to ·16	·02±	·50 to ·80	·09	·10
" telegraph	·12 to ·15		not over ·40	·04	·04
Wootz (Henry)	1·64	·045			·181

a A famous shell of Whitworth's: the metal had 213,000 pounds tensile strength per square inch, and an elongation of 11%, probably in two inches.
b Ship-plate is usually much like boiler-plate in composition, but with rather more phosphorus.
c American tyres are harder than British, probably chiefly because the brake-service is more trying, the weight of cars per wheel heavier, and the track rougher here than in Britain.
d It was necessary to keep the manganese below 0·45%. With higher manganese the turnings were so tough as to deflect the turning tool: with 0·35 to 0·4% of manganese the turnings broke off short.
e Rails habitually made at an American mill using cast-iron direct from the blast-furnace without remelting in cupolas.
f Open-hearth steel rails formerly made in South Wales from old iron rails. Bell, Principles of Manuf. of Iron and Steel, p. 427, 1884.
g The phosphorus is intentionally high, in order that the turnings may break off short, and not clog the cutting tools.
h Punched 27,000 fish-plates.
i Tapped 99,000 nuts.

the difference is slight, less than one fifth as great as the difference between the density of the molten metal and the minimum density which occurs slightly below the melting point

He deduced the following values.

Specific gravity of solid Cleveland gray cast-iron	6·95
" " " plastic " " "	6·50
" " " molten " " "	6·88

This explanation of the invariable floating of cool on molten iron is so simple and natural to one who has seen ice float on water, that we wonder as much as we regret that energy should have been diverted from our pressing needs to unpromising, far fetched, if ingenious attempts to attribute it to remote causes, which could hardly operate constantly.

CHAPTER XV.

Direct Processes.[a]

Wrought-iron and steel are usually made by the indirect method of first making cast-iron in the blast-furnace and then decarburizing it. Direct processes are those in which wrought-iron or spongy iron is made directly from the ore, and either used as such, or converted into steel, usually by melting it with cast-iron, more rarely by cementing it with carbonaceous matter: or in which weld- or even ingot-steel is made directly from the ore.

§ 310. Possibilities of the Direct Process.—Before confusing ourselves with the details of the numberless direct processes, let us in a general survey see what are the possibilities, not of this or that particular process, but of the direct process in general, what the advantages which we can conceive and may hence seek, what the necessary obstacles.

The fields for the direct process are the production of weld-metal (wrought-iron weld-steel) to be used as such, and of raw material for the open-hearth and crucible processes.

The former field I think holds out little promise, for weld-metal made by direct process is not only liable to red-shortness and slag-shortness, but also usually varies capriciously in its carbon-content and is markedly heterogeneous.

In the latter field direct-process metal must compete with scrap iron,[b] with cast-iron, and with puddled and charcoal-hearth iron. But if it can compete with the product of the blast-furnace alone (cast-iron), it can surely compete with puddled and charcoal-hearth iron, which have each undergone an additional very costly operation after passing through the blast-furnace; hence we may narrow the discussion and ask, "Can direct-process metal compete with scrap iron?" and "Can it compete with cast-iron?"

Competition with scrap iron. As a material for the crucible and acid open-hearth processes, I do not think that we can forecast the future of direct-process metal with complete confidence.

As a material for the crucible process, direct-process metal made from ores relatively free from phosphorus has a great advantage over most of the scrap iron in the market, in that its phosphorus-content may be known and guaranteed. For this purpose old steel rails are of course quite out of the race. But boiler-plate shearings of known composition are made in great quantities: and with more perfect organization the composition of the plates of worn-out boilers may be known and guaranteed. It is true that most if not all of even the best boiler-plate steel has more phosphorus than is desirable for the crucible process, which, I believe, will be ever more and more restricted to the production of the very best, *i. e.* the least phosphoric, classes of steel. But on the other hand, with the basic open-hearth process looming up, those interested in the future of direct processes should bear in mind that ere long boiler-plate containing even less than 0·02% of phosphorus may be made in enormous quantities. Much the same may be said of direct-process metal considered as competing with scrap iron as a material for the acid open-hearth process.

This process, however, should it continue to flourish, would demand much more scrap iron of guaranteed composition than is likely to be offered. Here, too, old rails are so heavily handicapped by their high phosphorus-content as to be out of the race, at least for the production of those classes of steel for which the open-hearth seems suited.

But it is as a material for the basic open-hearth that the future of direct-process metal seems brightest. We have in this country very extensive deposits of readily mined ore, too phosphoric for either the acid Bessemer or the acid open-hearth processes, but not sufficiently phosphoric to yield cast-iron desirable for the basic Bessemer process. Some of them are situated where fuel suitable for the direct and for the open-hearth processes is very cheap relatively to that suitable for the blast-furnace; the conditions here seem especially favorable to the combination of direct process with basic open-hearth, for the latter readily takes metal of any phosphorus-content whatsoever, high, low or moderate.

Now the extensive development of the basic open-hearth process which may be looked for in these fields, should in itself create a demand for scrap iron. How this demand is to be met one hardly sees.

It hardly seems probable that a great quantity of old rails will be offered. According to Poor's Manual there were about 82,000 miles of iron rails in this country in 1880, of which more than one-quarter had been taken up before 1888, so that on an average somewhere about 300,000 tons of old iron rails have been taken up per annum and sold. This is about the present production of open-hearth steel in this country, and about one-tenth of that of Bessemer steel.

Now no very large proportion of these old rails, so far as I can learn, goes into the open-hearth furnace. They are re-rolled, slit into bars of many kinds, etc. Nor does it seem probable, judging from the statements of railway engineers whom I have consulted, that the supply of old steel rails will increase rapidly. As the old iron rails are taken up, in many cases, *e. g.* where they have stood on sidings, on branches but little used, etc., they are replaced with nearly worn out steel rails. It seems probable that as the supply of old iron rails ceases, it will be about made good by that of worn out steel rails, of which a considerable quantity is now sold every year.

In the basic open-hearth process, then, we have a great prospective demand for direct-process metal and scrap

[a] See an article by Ledebur, Stahl und Eisen, VI., p. 576, 1886.

[b] In this discussion I use "scrap-iron" generically, to include scrap wrought-iron and scrap ingot-metal.

iron, a demand which is likely to outstrip any probable increase in the supply of scrap iron for sale, so that as a remainder we are likely to have a large demand which direct-process metal can fill.

§ 313. COMPETITION WITH THE BLAST-FURNACE.—In studying this question I consider the relative cost of making metallic iron, whether sponge, blooms or balls, by the direct process, and of making cast-iron in the blast-furnace. I assume that the two competing materials are, 1st, direct-process iron to be used in the open-hearth furnace with a little cast-iron (in a process parallel with the pig-and-scrap process); and, 2d, cast-iron to be used in the open-hearth furnace with ore, in the pig-and-ore process: and this without discussing the relative merits of the pig-and-scrap and the pig-and-ore processes.

If direct process iron can be made as cheaply or nearly as cheaply as cast-iron, it will of course be a much better material for the open-hearth process.

The cost of the combination, blast-furnace plus puddling, as preparatory to the open-hearth process, must ever remain so high that it will be chiefly confined to the production of steel of exceptional purity. Indeed, the basic open-hearth process threatens to extinguish the combination altogether as preparatory to the open-hearth process.

For making steel by the open-hearth and crucible processes we seek metallic iron without much carbon or silicon. In the blast-furnace we not only bring our iron to the metallic state, which can be done at a low temperature, but raise our deoxidized iron to a very much higher temperature, at vast outlay of fuel; this excess of fuel causes such energetic deoxidation that all the phosphorus of the ore is deoxidized and unites with the iron, as does much carbon and silicon, which must later be removed. This does not at first seem the straightest way, but it has enormous incidental advantages, in that the carbon and silicon absorbed prevent the metallic iron from reoxidizing; in that we obtain all the products in a molten condition, in which they can be very cheaply handled; in that we can convert the gangue into a sulphur-devouring basic lime-silicate and can melt this silicate, thus at once removing from the iron the gangue with which it is associated in nature, and the sulphur of the mineral fuel used for smelting.

This procedure, making steel by carburizing iron in the blast-furnace and again decarburizing it, has been long ridiculed as indirect and illogical. But the objection is rather of sentimental than practical importance, unless the indirect and illogical process necessarily costs more than the direct and logical one: metallurgy lives by profit, not logic. Indeed, the cheapest possible process for given results, quality and certainty included, no matter how indirect is logical when all factors are considered: it seems illogical only to the shallow logician who ignores certain premises.

A. *Advantages and Disadvantages of the Direct Process.*—For all ores the direct process has an advantage over the blast-furnace,

1, In yielding iron relatively free from carbon and thus fitter for the open-hearth and crucible processes.

2, In that its gentle deoxidizing conditions may permit dephosphorization—at the cost of heavy loss of iron. The loss of iron may, however, be avoided if dephosphorization be not sought, by strengthening the deoxidizing tendencies (Cf. § 315, B I.).

3, In that it can use fuels (producer-gas, water-gas, natural gas) which are often much cheaper than the anthracite, coke and charcoal to which the blast-furnace is apparently hopelessly restricted.

It is at a disadvantage.

4, In leading to greater absorption of sulphur if sulphurous (solid mineral) fuel is used, since at the usual low temperature of the direct processes we cannot melt and hence cannot use the desulphurizing lime slags.

5, In its greater outlay for labor, greater because operations are more scattered, and because the product is usually solid and less easily handled than the molten product of the blast-furnace.

6, In its probably necessarily greater loss of iron.

For rich ores it has a further advantage.

7, In requiring less fuel, thanks chiefly to its lower temperature.

8, In case of lean ores the fuel-consumption of the direct process may be brought below that of the blast-furnace, but only at the cost of heavy loss of iron, which however at the same time causes dephosphorization. The leaner the ore, the heavier the loss of iron to which we must submit in order to obtain the fuel-economy which the direct process permits.

B, *Applicability.* Hence the direct process is especially applicable,

1, To rich ores;

2, To cheap ores, especially if dephosphorization be needed;

3, Where fuel is dear;

4, Where fuels which, though nearly or quite sulphurless, cannot be used in the blast-furnace, are much cheaper per unit of calorific and reducing power than those fuels which are suited for the blast-furnace.

I believe that these are not simple accidents of the direct processes now proposed, but essential conditions of the problem.

§ 314. DISCUSSION.—Let us now consider in some detail the conditions which give rise to these advantages and disadvantages, first noting that as a material for the open-hearth process, it is not imperative that the product of the direct process should be completely deoxidized. Any small quantity of iron-oxide in the balls of spongy iron, if these were sufficiently dense to sink quickly beneath the slag of the open-hearth furnace, would probably be almost wholly deoxidized by the carbon (and silicon) of the bath during the early part of the process, especially if this were carried out on a basic lining. But towards the end of the operation, when the bath contains but little carbon, any oxidized iron in the sponge-balls would probably escape reduction and would be lost in the slag.

Fuel. To bring 100 parts of iron from the condition of iron ore to that of metallic iron the essential requisites are, enough chemical energy to deoxidize the iron, and enough heat energy to raise the ore to a temperature at which deoxidation can occur.

To deoxidize 100 of iron from magnetic oxide takes $100 \times 1582 = 158{,}200$ calories.

To develop this quantity of heat needs 19·5 parts of carbon burning to carbonic acid, while to satisfy the equation $Fe_3O_4 + 2C = 3Fe + 2CO_2$ needs only 14·3 parts of carbon. It is conceivable that during the subsequent cooling of the metallic iron and carbonic acid we can almost com-

pletely recover the heat expended in raising the iron oxide and carbon to the temperature of deoxidation: so that in one sense a consumption of 19·5 parts of carbon per 100 of iron may be taken as the limit towards which we work, and which in the nature of things we can never quite reach. But even if we admit that half of the heat used in heating the iron oxide and carbon must practically be thrown away, the carbon-requirement rises but little. Some forms of iron oxide begin to deoxidize at temperatures even below 150° C.: but here deoxidation is very slow and probably necessarily very incomplete. Probably it will always be expedient to heat the oxide at least to 800° C. (1472° F.). To do this requires

$$\left(100 \times \frac{100}{72{\cdot}4} \times 0{\cdot}17 + 19{\cdot}5 \times 0{\cdot}30\right)(800° - 20°) = 22{,}877 \text{ calories.}$$

(Fe_3O_4. S. H. C. S. H.)

Now, supposing that half of this heat is utilized when the products cool, to supply the other half requires 1·42 parts of carbon, which raises our total carbon-requirement to 21 parts per 100 of iron. In case of ferric oxide the requirement would rise to about 24 parts of carbon per 100 of iron.

As the necessary carbon-requirement is an extremely important factor in any forecast of the probable future of the direct process, let us seek it again in a wholly independent way.

For the deoxidation alone of ferric oxide by carbon, supposing that all the carbon were burnt to carbonic acid by means of oxygen yielded to it by the ore, by the reaction:—

$2Fe_2O_3 + 3C = 4Fe + 3CO_2$,

$4 \times 56 = 224$ of iron needs $3 \times 12 = 36$ of carbon, or 100 kg. of iron needs 16 kg. of carbon, which would develop $16 \times 8{,}080 = 129{,}280$ calories.

But to deoxidize 100 of iron by the above reaction demands $100 \times 1887 = 188{,}700$ calories, or 59,420 calories more than is developed by our carbon: and to develop this excess we must burn $59{,}420 \div 8{,}080 = 7{,}354$ kg. of carbon: so that altogether we need

Reducing carbon	16 kg.
Heating carbon	7·4 "
Total carbon	23·4 kg.,

or 26 parts of a fuel containing 90% of carbon.

But here we assume that all the heat developed in the apparatus and by the reactions is utilized with 100% efficiency, a condition manifestly unattainable: no less unwarrantable is our assumption that all the carbon is oxidized to carbonic acid by the oxygen of the ore. But I think it within the bounds of possibility that a direct process should be devised in which the carbon would be oxidized by the ore so fully that the ratio $\frac{CO_2}{CO}$ in the escaping gases would be 1·34 by weight:[a] in which the reduction could be practically completed without raising the temperature above 800° C.: in which 90% of the heat given out by the spongy iron in cooling from this temperature to 250° C. could be utilized,[b] admitting that all the heat given out as the products cool from 250° down is lost: in which the heat evolved by the combustion of the carbon to $\frac{CO_2}{CO} = 1{\cdot}34$ could be practically completely utilized in heating and reducing the ore: and in which 75% of the heat evolved by the further combustion of the escaping gases could be utilized. But the heat developed by reducing fuel and the escaping gases would not suffice for reducing and heating the ore: additional fuel must be supplied: and we may asssume that it is within the bounds of possibility that 75% of the heat evolved in burning this fuel would be utilized. Under these assumptions and neglecting the moisture in the blast, we may calculate the fuel requirement as follows for an ore with 10% of gangue, 90% of ferric oxide, or 63% of iron:

Composition of the Gases.—The ratio $\frac{CO_2}{CO}$ being 1·34, we would have of carbon burning to carbonic acid $\frac{1{\cdot}34 \times 12}{32 + 12} = {\cdot}366$, and to carbonic oxide $\frac{1 \times 12}{16 + 12} = {\cdot}4285$: or $\frac{{\cdot}366 \times 100}{{\cdot}366 + {\cdot}4285} = 46{\cdot}04\%$ of the carbon burns to carbonic acid, and 53·96% to carbonic oxide: so that each equivalent of carbon takes up 1·46 of oxygen. Hence to deoxidize 100 kg. iron we need

$16 \times \frac{2}{1{\cdot}46} =$ 21·92 instead of 16 kg. of carbon: of which

$21{\cdot}92 \times {\cdot}4604 = 10{\cdot}09$ kg. burn to carbonic acid, and

$21{\cdot}92 \times {\cdot}5396 = 11{\cdot}83$ burn to carbonic oxide.

21·92

The waste gases from the reducing apparatus then will contain, per 100 kg. of iron,

$10{\cdot}09 \times \frac{32}{12} = 26{\cdot}84$ of oxygen, or 36·93 kg. of carbonic acid:

$11{\cdot}83 \times \frac{16}{12} = \frac{15{\cdot}73}{42{\cdot}57}$ of oxygen, or 27·56 kg. of carbonic oxide.

As the carbon is supposed to be oxidized by the oxygen of the ore, the waste gases escaping from the ore-reducing chamber may be supposed to be free from nitrogen.

Heat Requirements.—Heating the following substances from 20 to 800° C., a range of 780°.

	Kg.	SH.	Calories.
100 of iron[c]	100	× ·169 = 16·9	
$100 \times \frac{10}{63} = 15{\cdot}87$ of gangue	15·87	× ·22 = 3·5	
36·93 carbonic acid	36·93	× ·2164 = 7·992	
27·56 " oxide	27·56	× ·2479 = 6·832	
Total W. × SH		35·224	
780 × 35·224			27 475
Reduction of 100 of iron, 100 × 1,887 =			188,700
			216,175

Heat Development.—

10·09 kg. of carbon burn to carbonic acid 10·09 × 8,080	81,530
11·83 kg. burn to carbonic oxide 11·83 × 2,473	29 250
90% of the heat given out by gas, sponge and gangue, in cooling from 800° to 250°, W. × SH. × 550 × ·90 = 35,224 × 550 × ·90 =	17,435
75% of the heat evolved in the further combustion of 27·56 kg. of carbonic oxide to carbonic acid, 27·56 × 2,403 × ·75	49,670
In order to bring the sum up to the heat requirement we must burn 6·32 kg. of carbon, which by assumption would contribute of available heat 8,080 × ·75 × 6·32 =	38 290
	216,175

Reducing carbon needed	21·92 kg. per 100 kg. of iron.
Heating carbon needed	6·32
Total	28·24 or, say 30 kg.

To sum this up, under the several sets of assumptions the carbon requirement for 100 of iron is as follows:—

	For deoxidation.	For heating.	Total.
Pure magnetite	19·5	1·42	21
Pure ferric oxide, 1st calculation	....	....	24
" " 2d "	16·00	7·40	23·4
90% ferric oxide, 10% gangue	21·92	6·32	28·24

I repeat, these are limits towards which we may work.

[a] The gases from the Björnbyttan charcoal blast-furnace are reported to have this composition: Bell, Princ. Manuf. Iron and Steel, pp. 276-9, from Åkerman.

[b] The temperature of the gases escaping from the Consett No. 4 and the North Chicago No. 7 furnaces is reported as 248° and 249° C. respectively. Gordon, Journ. Iron and Steel Inst., 1886, II., p. 784.

[c] This is not strictly accurate, because during the first part of the operation we are heating oxide of iron and carbon instead of iron and oxide of carbon. But the error thus introduced is not sufficient to affect our results materially.

Now we find that the modern blast-furnace, wonderfully efficient[a] thermo-chemical engine that it is, almost always uses more than twice and usually more than thrice the largest quantity of fuel above calculated. The following are among the best results thus far published.

	Pounds of carbon per 100 pounds of pig-iron.
Consett furnace	78·9 b
North Chicago Coke Furnace, probably 1885	67·95 c
Martel Charcoal Furnace	54·90 d

While part of the difference is due to our assuming a higher efficiency for the direct process, smaller losses of heat by radiation, etc., than are actually attained in the blast furnace, yet the greater part is clearly due to the fact that the blast furnace does much work which the direct process may avoid.

To compare the requirements of the direct process with those of the blast-furnace, I give in the following table the heat requirements of the latter when smelting Cleveland ore, according to Bell, and those of a direct process in which I assume that the charge is heated to 800° C., that no limestone is used, that neither phosphoric nor silicic acid is deoxidized, and that the loss by radiation, tuyere-water, expansion of blast, etc., is but little more than half as great as in the blast-furnace.

TABLE 152.—HEAT REQUIRED FOR MAKING 20 KG. OF PIG-IRON, AND SPONGE CONTAINING THE SAME QUANTITY (18·6 KG.) OF IRON, FROM CLEVELAND ORE.

	Pig-iron.[a]			Sponge.		
	Kg.	Cal.	Cal.	Kg.	Cal.	Cal.
Evaporation of the water in the coke.	·58 ×	540 =	313	·30 ×	540 =	162
Reduction of 18·60 kg. of iron from ferric oxide	18·60 ×	1,780 =	33,108	18·60 ×	1,780 =	33,108
Carbon impregnation	·60 ×	2,400 =	1,440			
Expulsion of carbonic acid from limestone	11·00 $CaCO_3$	370 =	4,070			
Decomposition of carbonic acid from limestone	1·32 C	3,200 =	4,224			
Decomposition of water in blast	·05 H	34,000 =	1,700			900
Reduction of phosphoric, sulphuric and silicic acids			3,500			
Fusion of cast-iron	20·00 ×	330 =	6,600			
Fusion of slag	27·92 ×	550 =	15,356			
Heating iron: Kg. S. H. To 800° C., 18·6 × ·169 × 800						2,518
Heating gangue: Kg. S. H. to 800° C., 22·2 × ·22 × 800						3,907
Radiation, tuyere-water, expansion of blast, etc.			8,789			4,500
Carried off in escaping gas			7,900			4,000
			87,000			49,095

[a] Bell, Princ. Manuf. Iron and Steel, p. 95, 1884.

These numbers indicate that, with approximately like efficiency, the direct process may be carried on with a little over half the fuel-consumption of the blast-furnace: and I fancy that this is not very far from the point which it may some day reach.

As already hinted, the chief reason for the greater fuel-consumption in the blast-furnace is that the material is heated, not merely to the temperature of rapid deoxidation, say 800° C., but to a vastly higher temperature, so as to completely liquefy the product. When mineral fuel is used the sulphur which it contains would, unless special precautions were taken, contaminate the iron. To prevent this it is necessary that the slag should contain much lime, so that the sulphur may enter the slag as sulphide of calcium, instead of combining with the iron.

But these highly calcareous slags are exceedingly infusible. In order to liquefy them completely the temperature is raised not simply to the melting point of cast-iron, say 1,050° C. for white iron and 1,200° C. for gray, but probably at least to 1,600° C., and much higher when the open gray iron needed for the Bessemer process is made.[e] This high temperature plays another important part in making iron for the Bessemer process: it affords the strongly carburizing and deoxidizing conditions which give the iron a high proportion of carbon and silicon, but which have a compensating disadvantage in deoxidizing the phosphorus of the burden, and thus causing it to enter the iron.

Beyond this, in using lime we increase the fuel requirement not only by increasing the quantity of material to be heated and melted, but because the decomposition of the limestone absorbs heat, and because the carbonic acid driven off from it attacks the carbon of the fuel, by the reaction

$$CO_2 + C = 2CO,$$

both consuming fuel and absorbing heat.

Again, the deoxidation of phosphoric, sulphuric and silicic acids, and the absorption of carbon by the iron, demand heat and fuel.

In an example given by Bell the items calculated in the last two paragraphs consume 0·48 times as much, the sensible heat carried out by the molten products is 0·70 times as great, and that carried out by radiation, by the tuyere-water and by the escaping gases 0·40 times as great, as the heat needed for deoxidation proper,[f] which is thus but about one-third of the total heat-requirement.

Finally, the high temperature of the blast-furnace greatly increases the loss of heat by radiation and by the tuyere-water: but this is partly offset by its great compactness and concentration. In short, it is clear that, as far as fuel-requirement is concerned, the uncarburetted and hence more valuable product of the direct process should be more cheaply produced than cast-iron.

But, as we shall see, this advantage may, except in case of rich ores, be more apparent than real, since the further treatment of the direct-process metal in the open-hearth or crucible process may necessitate reheating the gangue of the ore to a temperature which is very much higher, and with a heating-efficiency which is very much lower, than those of the blast-furnace: a reheating wholly dispensed with in case the ore is treated by the blast-furnace instead of by direct process.

Cost of Installation. It is generally believed that the output of the direct process from plant of given cost is and must be much less than that of the blast-furnace: but I doubt if this is true. To give a rough idea of the relative cost of installation for the direct and for the blast-furnace process, I here estimate the annual output of iron from $40,000 worth of plant, *i. e.*, the annual output for each $40,000 of cost of installation.

American Bloomary. Assuming that each fire turns out 300 tons a year: furnace assumed at $600, ⅓ of a hammer assumed at $234, other items, excluding buildings, at

[a] Gruner estimated that in large blast-furnaces from 70 to 88% of the heat generated was utilized. In an example given by Bell 81% of the heat developed is usefully applied. In another case 74% of the total calorific power of the fuel is utilized. (Princ. Manuf. Iron and Steel, p. 144, 1884.)

[b] Gruner, Studies of Blast-Furnace Phenomena, L. D. B. Gordon, p. 78, 1874.

[c] F. W. Gordon, Journ. Iron and Steel Inst., 1886, II., p. 784.

[d] Bell, Princ. Manuf. Iron and Steel, pp. 301–4. 1884, from Journ. U. S. Ass. Charcoal Iron Workers, III. From this number, 54·9, we should apparently deduct something like three pounds, to allow for the carbon taken up by the iron, in order to make this case comparable with the others: so that here the carbon burned is about 52 pounds per 100 of cast-iron produced.

[e] Bell found that wrought-iron, whose melting-point is not far from 1,600° C., was partly melted when held in a stream of slag from a blast-furnace making No. 3 pig-iron (Journ. Iron and Steel Inst., 1871, I., p. 299).

[f] Journ. Iron and St. Inst., 1871, I., p. 279.

(TO BE CONTINUED.)

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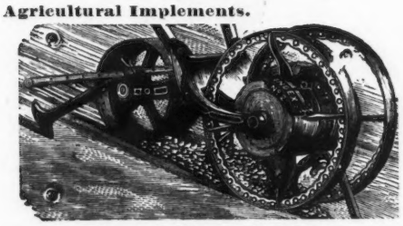
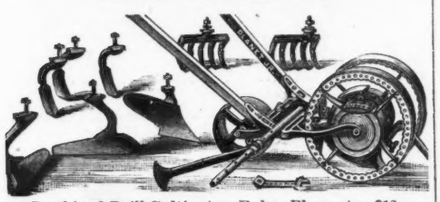


"Planet, Jr." No. 2 Seed Drill, $9.



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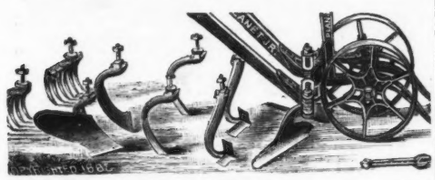
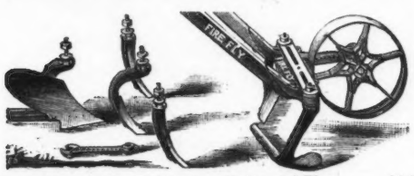
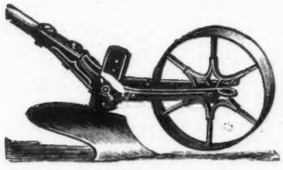


Double-Wheel Hoe Rake, Plow, etc..... $8.00
Double-Wheel Hoe, plain (Hoe's only)..... 4.50



Single Wheel Hoe Cultivator, Rake and Plow..... $6.00

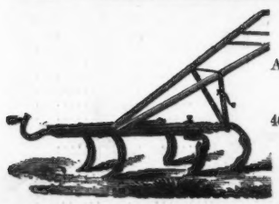


"Fire Fly" single-wheel Hoe, Cultivator and Plow, $5.

"Fire Fly" Hand Plow, $2.50.

30 % discount, f.o.b. New York.

All Steel Horse Hoe and Cultivator combined, with wheel, $11.



All Steel Plain Cultivator, $6.00.

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HAY FORKS.

Ely Hoe & Fork Co.—Gold Finish, Patent Overcaps.

Three Tine Forks.

No.	Tine.	Handles.	Per doz.
30	10 in.	4½ ft. Boy's	$7.75
32	12 "	4 to 6 ft.	9.00
32 S	12 "	" Strapped	10.50
32 B	12 "	" Bent	9.50
32 B S	12 "	" Bent & St'pd	11.00
33	12 "	"	9.50
33 S	13 "	" Strapped	11.00
33 B	13 "	" Bent	10 00
33 B S	13 "	" Bent & St'pd	11.50
34	14 "	"	10.25
34 B	14 "	" Bent	10.75
35	15 "	"	11.25
35 B	15 "	" Bent	11.75
42 B	12 "	" Bent	12.50
42 B S	12 "	" Bent & St'pd	14.00

Manure Forks, Solid Steel Shanks, Gold Bronze Finish, Patent Overcaps.

No. 44, oval, 4 tine, 12 in. tine, 4 ft. handle, plain ferrules, $12.50 per doz.

No. 44 S, oval, 4 tine, 12 in. tine, 4 ft. handle, strapped ferrules, $14.

No. 44½, oval, 4 tine, 12 in. tine, 4½ ft. handle, plain ferrules, $12.50.

No. 44½ S, oval, 4 tine, 12 ft. tine, 4½ ft. handle, strapped ferrules, $14.

No. 54, oval, 5 tine, 13 in. tine, 4 ft. handle, plain ferrules, $19.50.

No. 54 S, oval, 5 tine, 13 in. tine, 4 ft. handle, strapped ferrules, $21.

No 64, oval, 6 tine, 13 in. tine, 4. ft. handle, plain ferrules, $22.50.

No. 64 S, oval, 6 tine 13 in. tine, 4 ft. handle, strapped ferrules, $24.

HOES.

Ely Standard Socket, all Gold Bronze Neck, full Pol'd, C. S. Blade.

Field, 7 × 5 in., selected handles..$9.00
" 7½ × 4½ " " " .. 9.00
" 8 × 4¾ " " " .. 9.00
" 8½ × 4½ " " " .. 9.00
" 8 × 5 " " " .. 9.00
Washington County Pattern, spring handles..... 10.00
Rhode Island, 7 to 9 in., spr'g handles 9.00
" " 9½ in. " " 9.25
" " 10 " " " 9.50
Meadow, 9 × 4 in., poplar handles..... 9.00
Meadow, 9½ × 3½ in., poplar handles..... 9.25
Meadow, 10 × 3½ in., poplar handles..... 9.50
Broom Corn, 7½ × 4½ in., poplar handles..... 9.00

Popular Handles in Meadow Socket Hoes, unless otherwise ordered.

PLOWS.

Reversible Oneonta Clipper.

16. Oneonta Clipper, Reversible, Iron beam Cutter..... $14
" Oneonta Clipper, Reversible, Iron Wheel and Cutter..... 15
18. Oneonta Clipper, Reversible, Iron Beam Cutter..... 15
" Oneonta Clipper, Reversible, Iron Beam, Wheel and Cutter.... 16
17. Hard Metal, Reversible, Iron Beam Cutter..... 17
17. Hard Metal, Reversible, Iron Beam, Wheel and Jointer..... 17
19. Hard Metal, Reversible, Wood Beam Cutter..... 16
" " " " " " Wheel and Jointer..... 17
20. Steel Mould Board, Reversible, Wood Beam Cutter 15
" " " " " " Wheel and Cutter..... 16

Iron Beam Plows.

Two-horse Sod and Stony Land.... 8.50 plain.
Curtis's Sod Two horse..... 11.50 "
" " " " ..... 13.00 cutter.
" " " " ..... 14.25 wheel & cutter.

Subsoil Plows.

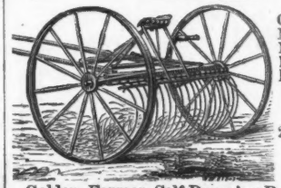
Two-horse 9.50 Draft Rod.
" " 11.00 Wheel and Draft Rod.

Hitchcock's Potato Digger and Shovel Plow.

Improved adjustable handle shovel plow..... 7.00
Hitchcock's Potato Digger..... 8.00
" " " and shovel plow..... 10.50
Dis. 30%.

RAKES.

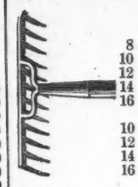
The S. R. Nye Improved.
22 Teeth Rake, $32.00
26 " " 34.00
25% dis.



Chieftain Lock Lever
No. 1..... $30.00
No. 2..... 30.00
No. 5..... 29.00
Iron wheels, $2 extra.
With Pole, Double Tree and Neck Yoke, $2 extra.
22 cubic feet packed, 400 lbs. gro., 225 lbs. net.

Golden Farmer Self-Dumping Rake, $37.00; 22 cu. ft., 430 lbs. gro., 250 lbs. net.
Chieftain Hay Tedders, $59.00; 700 lbs. gro., 450 lbs. net.
Potato Diggers, $7.00; 100 lbs. gro., 60 lbs. net; dis., 40% f.o.b. ship New York or Boston.

RAKES (GARDEN).



Braced steel garden rakes. Per doz
8 teeth..... $8.00
10 " 9.00
12 " 10.00
14 " 11.00
16 " 12.00

Braced malleable garden rakes.
10 teeth..... $5.50
12 " 6.00
14 " 6.50
16 " 7.00

Smith-Harper Riveted Garden Rakes, Wood Heads.

No.	Wrought teeth.	Per doz.
8-teeth rakes, wrought, 6 feet handles		$5.00
10	" " "	5.50
12	" " "	6.25
14	" " "	7.00

Best Polished Cast Steel Rakes.

No.	Handles.	Per doz.	No.	Handles.	Per doz.
1—16 teeth,	6 feet	$12.00	4—10 teeth,	6 feet	$9.00
2—14 "	6 "	11.00	5—8 "	6 "	8.00
3—12 "	6 "	10.00	6—6 "	5½ "	6.00

Lawn or gravel rakes, price same cast steel garden rakes
Tar rakes, 14 teeth, 18 inch, iron shank, 4½ feet handles, net..... $12.00

Malleable Iron Garden Rakes.

No.			Handles.	Per doz.
8—8	teeth,	polished,	5½ ft. handles	$5.00
10—10	"	"	6 "	5.50
12—12	"	"	6 "	6.00
14—14	"	"	6 "	6.50
16—16	"	"	6 "	7.00

10 doz. case lots, 60, 10 and 5% cased.

Geneva Tool Co.

Ten-Teeth	Malleable Garden. Plain.	Braced.	Steel Garden. Plain.	Braced.
10-Teeth	$5.50	$6.00	$9.00	$10.50
12 "	6.00	6.50	10.00	11.50
14 "	6.50	7.00	11.00	12.50
16 "	7.00	7.50	12.00	13.50

Dis. 70 and 5%.

Cast steel garden rakes.

Per doz.
10 teeth, polished, tapering bar, tempered rake. $9.00
12 " " " " " " " 10.00
14 " " " " " " " 11.00
16 " " " " " " " 12.00

Cast steel lawn rakes.

12 teeth, polished, tapering bar, tempered rake..... $10.00
14 teeth polished tapering bar, tempered rake..... 11.00
16 teeth polished tapering bar, tempered rake..... 12.00
18 teeth polished tapering bar, tempered rake..... 13.00
Dis. 70% from Standard Association list.
Prices made where XX handles, etc., are required.

SCYTHES (GRASS).

Waldron's pattern, oiled..... $8.50
Silver steel, painted..... 8.50
Western dutchman, bronzed and painted..... 9.00
Clipper, polished web..... 9.00
Fine cutlery steel, full polished..... 10.00
All steel, full polished..... 11.00

Grain Scythes.

Waldron's pattern, oiled..... 11.25
Silver steel, painted..... 11.25
Clover, oiled..... 11.25
Clipper, bronzed and painted..... 11.50

Lawn Scythes.

Clipper, bronzed and painted..... 9.00
Dis., 40 and 10%.

SOWER, BROADCAST SEED.

Per dozen..... $36 f.o.b.
Gross wt., 110 pounds per dozen
Net wt., 75 pounds per dozen.

Apple Parers.

Little Gem.

	Per doz.
Advance	$4.75
Baldwin	5.25
Champion	7.25
Hudson's '88	3.75
Improved Bay State	30.
Monarch	31.50
Oriole	4.00
Turntable	4.50
Victor	13.50
White Mountain	4.50
Rocking Table	4.25
Little Gem Corer and Slicer	3.7

Rocking Table.

Anvils.

"Eagle anvils."

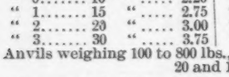
	Weight about			Weight about	
No. 000	½ lb	$1.00	No. 4	40 lbs	$4.25
" 00	4 "	1.70	" 5	50 "	5.05
" 0	10 "	2.20	" 6	60 "	5.50
" 1	15 "	2.75	" 7	70 "	6.00
" 2	20 "	3.00	" 8	80 "	7.00
" 3	30 "	3.75	" 9	90 "	8.00

Anvils weighing 100 to 800 lbs., 10 cts. per lb. Discount 20 and 10 %.

Arms and Ammunition.

Wood Powder.
American Wood Powder Company.
¼ kegs.

	Kegs, 25 lbs.	6¼ lbs.	1 lb. cans.
Trap for first quality arms only	$19.50	5.00	.85
A, for large bore C, for general use D, fine for small bore and rifles E, very fine for small bore rifles and gallery shooting	17.00	4.35	.75



Hartley & Graham, Union Metallic Cartridge.

	Discount. Per cent.	
Bullet Breech Caps, per lb.	1.60	10
Conical Bullet Caps "	1.75	10
Rim Fire Cartridges	60	10
Military Rim Fire Cartridges	15	10
Central Fire Pistol and Rifle Cartridges	40	10
Central Fire Metallic Cartridges for Target and Sporting Rifles	30	10
Military Cartridges, Central Fire	30	10
Lefaucheux Cartridges		60
Gatling Cartridges		Special
Primed Shells and Bullets	25	10
Friction Cannon Primers	20	10
Primers		10
Percussion Caps, F. C., per M.	33c.	
U. M. C. "	42½c.	
Musket "	45c.	
Brass Shot Shells, U. M. C., 1st qual	60	10
Club brand	65	10

Paper Shot Shells.

14, 16 and 20 ga. First quality, 30, 10 and 10 per cent; 4, 8, 10 and 12 ga., First quality, 25, 10 and 10 per cent.
14, 16 and 20 ga. Club brand, 30, 10 and 10 per cent.
10 and 12 ga. Club brand, 33⅓, 10 and 10 per cent.
Gun Wads, 20 and 5 per cent.

REVOLVERS.

Smith & Weston

32, Single Action, 3, 3½ in., $8.00.
32, Double Action, 3, 3½ in., $9.35.
32, Safety Hammerless, 3, 3½ in., $11.00.
38, Single Action, 3¼ in., $9.40; 38, Single Action, 4 in., $9.65; 38, Single Action, 5 in., $10.00; 38, Double Action, 3¼ in., $10.40; 38, Double Action, 4 in., $10.65; 38, Double Action, 5 in., $11.00; 38, Safety Hammerless, 3¼ in., $12.00; 38, Safety Hammerless, 4 in., $12.25; 38, Safety Hammerless, 5 in., $12.50; 44, Single Action, 4 in., $11.50; 44, Single Action, 5 in., $11.75; 44, Single Action, 6, 6½ in., $12.00; 44, Double Action, 4 in., $12.50; 44, Double Action, 5 in., $12.75; 44, Double Action, 6½ in., $13.00; 44, Double Action Favorite, 5 in., $12.75.

Colts.

Discount, 10 per cent from following prices.

Double Action Army, 44 and 45 calibre, 4¾, 5½, 7½ inch bbl., $13.00.
Double Action, 41 calibre, 2½ to 6 inch bbl., $11.20.
" " 38 " 2½ to 6 " " $10.00.
Single " Army, 45 calibre, 4¾, 5½, and 7½ inch bbl., $12.00.
Single Action Army, 44 calibre, "Frontier," 4¾, 5½, and 7½ inch bbl., $12.00.
New Line, 41 calibre, blued or nickeled, $4.00.
" " 32 " " " 4.00.
" " 30 " " " 2.00.
" " 22 " half or full plate, 2.10.
Old Model, 22 calibre, by the hundred, half or full plate, $1.50.
Colt Deringer. 41 calibre, per pair half or full plate, $5.50.

American Bull Dog

Double Action 32, 38 and 44 calibre, 2½ inch barrel, $1.60; Double Action 32, 38 and 44 calibre, 4½ inch barrel, $1.85; Double Action 32, 38 and 44 calibre, 6 inch barrel, $2.10.

F. & W. British Bull Dog revolvers, 32 and 38 calibre 2½ inch bbl., $1.80.
F. & W. Automatic revolver, 32 and 38 calibre, 3¼ inch bbl., $5.50.
H. & R. Automatic revolver, 32 and 38 calibre, 3¼ inch bbl., $4.75.
Defender revolvers, Single Action, 22, wood handle, 65.
" " " " " 22, rubber " 70.
" " " " " 32, wood " 85.
" " " " " 32, rubber " 90.
Remington Army revolver, Single Action, 44 cal., frontier cartridge, 5¾ inch barrel, $6.50.
Remington Army revolver, Single Action, 44 cal., frontier cartridge, 7½ inch barrel, $6.00.
Remington Double Deringers, 41 cal., rim fire, $4.05.
National Deringers, 41 calibre, per pair, half or full plate, $4.00.
New House, 41 or 38 calibre, blued or nickeled, $5.00.
" Police, 38 calibre, 6 in., " " 7.00.
" " 38 " 4½ in., " " 7.00.

RIFLES.

Colts' Lightning Magazine.

Discount 10 per cent.

40/60 and 45/60 calibre octagon barrel	10 lbs.		$15.38
" " " " round "	9¾ "		14.25
" " " " carbine "	9 "		14.25
32, 38, and 44 calibres, octagon "	7¼ "		13.50
" " " " round "	6¾ "		12.38
" " " " carbine "	6¼ "		12.38
" " " " baby carbine	5¼ "		12.38
22 calibre, rim fire, octagon barrel			15.38
" " round			14.25

Remington Light (Baby) carbines, 44 cal., nick., $7.50.

Assay Furnace.

Hydro-Carbon Blow-Pipe Assay Furnace.

No. 2, Muffle Furnace taking C Battersea Muffle 8x4¾x3 in. $10.00
No. 3, taking F Muffle, 10x6x4 in. 15.00
No. 1, Crucible Furnace, taking Battersea, U or Colorado B Crucible, 4 in. dia. 5½ deep. 4.00
No. 2, taking Battersea E, round, 5 in. dia., 6½ deep. 5.00
Blow-Pipe No. 1, with half gallon tank, made of plain, strong sheet metal. 18.00
Blow-Pipe No. 2, with half gallon tank, made entirely of seamless brass. 23.00
Blow-Pipe No. 3, with one gallon tank, otherwise same as No. 2. 26.00
Blow-Pipe No. 1, Muffle Furnace No. 2, and Crucible Furnace No. 1. 32.00
Blow-Pipe No. 2, Muffle Furnace No. 2, and Crucible Furnace No. 1. 37.00

Axes, etc.

Shingling Hatchets.

	1.	2.	3.	
Collins',	$4.75,	$5.25,	$5.75	doz., dis. 10%.
Peck's,	$8.00,	$8.50,	$9.00	doz. dis. 45%.
Ryder's,	$8.00,	$8.50.	$9.00	doz., dis. 50%.

Claw Hatchets.

	1.	2.	3.	
Collins',	$5.25,	$5.75,	$6.25	doz., dis. 10%.
Peck's,	$9.00,	$9.50	$10.00,	doz., dis. 45%.
Ryder's,	$9.00,	$9.50,	$10.00	doz., dis. 10%

Hatchets, Broad Single Bevel.

Collins', cut in., 5, $9.50; 5½, $10.00; 6, $10.50; 6½, $11.00; 7½, $11.50; dis. 10%.

Peck's, cut in., 4, $10.50; 4½, $11.50; 5, $13.00; 5½, $14.50; 6, $16.50; 6½, $18.00; 7½, $19.50; 8¼, $22.00; dis. 45%.

Ryder's, cut in., 5, $13.00; 5½, $14.50; 6, $16.50; 6½, $18.00; 7½, $19.50; dis. 50%.

Adzes.

	House. Half flat head. Dozen.	Ship spur poll. Dozen.	Discount. Per cent.
Collins'	$14.00	$13.00	10
Peck's	24.00	25.00	45
Ryder's	24.00	25.00	50

Broad Axes—Pittsburgh Pattern.

5 to 8 pounds, $32.00 dozen.
7 to 9 pounds, $35.00 dozen.
8 to 10 pounds, $38.00 dozen.
9 to 12 pounds, $45.00 dozen.
Western pattern same price.

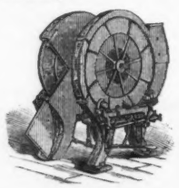
Spanish Pattern. Detumba round eye, $10.50 per doz.

Spanish Pattern Media labor, $12.25 per dozen.

Axle Grease.

Frazer's (2-lb. tins), per gross. $18.00
2-lb. wooden boxes, " 12.00
Discount, 25 and 5 %.
Dixon's Everlasting, boxes 1 lb., per doz. $1.20
" " " 2 lbs., " 2.00

Barrel Machinery.



Stave Jointers.

Single Wheel Beer Keg Stave Jointer,	16 to 22 in.	8	8	$190
Double " " " "	16 " 22 "	8	8	330
Single Wheel Half Barrel " "	24 " 30 "	8	8	275
Double " " " "	24 " 30 "	8	8	440
Single " Barrel " "	30 " 36 "	8	8	330
Double " " " "	30 " 36 "	8	8	500
Double Independent Barrel Stave Jointer with Wheels, on separate shafts, but suspended in one frame, 30 to 36 in.		8	8	520
Single Wheel Barrel Stave Jointer,	32 to 38 in.	8	8	350
Double " " " "	32 to 38 " .	8	8	550
Double Independent Barrel Stave Jointer,	32 to 38 in.	8	8	575

Bellows.

Miner's Bellows: 24 in., $8.50; 26 in., $9.75; 28 in., $11.00; 30 in., $11.25; 32 in., $13.50.
60 and 5% dis.
Standard, each: 18 to 24 in., $10; 28 in., $12; 32 in., $14; 34 in. $16; 36 in., $18; 38 in., $20; 40 in., $23; 44 in., $32.
60 and 5% dis.
Hand Bellows, per doz.: 6 in., plain, $10; fancy, $20; 7 in., plain, $12; fancy, $24; 8 in., plain, $14; fancy, $28; 9 in., plain, $16; fancy, $32; 10 in., plain, $18; fancy, $36.
50% dis.

Belting and Packing.

LEATHER BELTS.

Newark Leather Belting.
Single belts per foot.

Width.		Width.		Width.	
1 inch	.10	6 inch	.76	20 inch	2.84
1¼ "	.13	7 "	.90	21 "	3.02
1½ "	.17	8 "	1.02	22 "	3.20
1¾ "	.20	9 "	1.15	23 "	3.37
2 "	.23	10 "	1.29	24 "	3.54
2¼ "	.26	11 "	1.42	26 "	3.92
2½ "	.30	12 "	1.55	28 "	4.30
2¾ "	.33	13 "	1.68	30 "	4.64
3 "	.36	14 "	1.82	32 "	5.00
3½ "	.43	15 "	1.98	34 "	5.35
4 "	.50	16 "	2.14	36 "	5.70
4½ "	.56	17 "	2.31	40 "	6.40
5 "	.63	18 "	2.49	44 "	7.10
5½ "	.70	19 "	2.66	48 "	7.80

Double belts twice the price of single.
Dis. single and double belts, cemented, 50 and 5%.
Dis. single and double belts, riveted and cemented, and 5%.
Dis. single belts, cemented and lacesewn, water proofed, 50%.
Dis. double belts, cemented and lacesewn, water proofed, 45%.

LINK BELTING.

Link-Belt Machinery Co.'s. Price per running foot net.

No.	Price.	No.	Price.
25	$0.13	78	$0.40
32	.13	83	.45
33	.12	85	.50
34	.13	88	.50
35	.14	95	.60
42	.16	103	.75
45	.16	105	.70
51	.20	106	.90
52	.25	107	.80
55	.22	108	.80
57	.24	109	.90
62	.30	114	1.10
66	.30	122	1.50
67	.30	124	1.30
75	.35	146	1.40
77	.35		

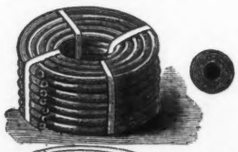
Sprocket wheels. 25%

RUBBER BELTING.

Inches.	2 ply per foot.	3 ply per foot.	4 ply per foot.	5 ply per foot.	6 ply per foot.
1	$0.07	.....	.....	.....	.....
1¼	0.09	.....	.....	.....	.....
1½	0.11	.....	.....	.....	.....
2	0.15	$0.17	$0.21	.....	.....
2½	0.18	0.22	0.26	.....	.....
3	0.22	0.26	0.31	.....	.....
3½	0.26	0.30	0.37	.....	.....
4	0.30	0.34	0.42	.....	.....
4½	0.33	0.39	0.47	.....	.....
5	0.36	0.43	0.52	.....	.....
6	0.43	0.52	0.62	.....	.....
7	0.51	0.60	0.73	.....	.....
8	0.59	0.70	0.84	$1.05	$1.25
9	0.67	0.80	0.95	1.18	1.42
10	0.75	0.90	1.07	1.33	1.60
11	0.83	1.00	1.18	1.47	1.77
12	0.91	1.08	1.30	1.62	1.95
13	1.00	1.18	1.42	1.77	2.13
14	1.08	1.28	1.54	1.92	2.31
15	1.16	1.38	1.66	2.07	2.49
16	1.25	1.50	1.78	2.22	2.67
18	1.41	1.70	2.02	2.52	3.03
20	1.58	1.90	2.26	2.82	3.39
22	1.76	2.12	2.52	3.15	3.74
24	1.96	2.36	2.80	3.50	4.20
26	2.18	2.60	3.08	3.85	4.62
28	2.42	2.84	3.36	4.20	5.04
30	.....	.....	3.64	4.55	5.46
32	.....	.....	3.92	4.90	5.88
34	.....	.....	4.20	5.25	6.30
36	.....	.....	4.48	5.60	6.72
38	.....	.....	4.76	5.95	7.14
40	.....	.....	5.04	6.30	7.56
42	.....	.....	5.32	6.65	7.98
44	.....	.....	5.60	7.00	8.40
46	.....	.....	5.88	7.35	8.82
48	.....	.....	6.16	7.70	9.24
50	.....	.....	6.44	8.05	9.66
52	.....	.....	6.72	8.40	10.08

Dis. High Grade, 60 and 5. Dis. Royal, 60, 10 and 10.
Dis. Manhattan. 70 and 5.

PACKING.

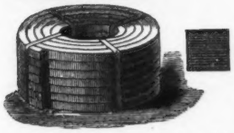


Piston Packing.

Round Piston Packing. Per lb. 85c. Discount, 60, 10 and 5 per cent.

Square Piston Packing.

Price same as above. Round and square piston packing is made in lengths of twelve or twenty-four feet.



Square Piston Packing. Rubber back, per pound $1. Discount 60 per cent. Best only.
Square piston packing, rubber back is made in engths of twenty feet.

Steam Packing.
Cloth Insertion, Rubber Outside.
Cloth Insertion, Cloth on one or both sides.

Thickness.	1-Ply.	2-Ply.	3-Ply.	4-Ply.
1-64 inch	70 cts.	.....	.....	.....
1-32 "	65 cts.	.....	.....	.....
1-16 "	60 cts.	63 cts.	66 cts.	.....
3-32 "	55 cts.	58 cts.	61 cts.	.....
1-8 "	55 cts.	55 cts.	58 cts.	61 cts.
3-16 "	55 cts.	55 cts.	55 cts.	58 cts.
1-4 "	55 cts.	55 cts.	55 cts.	55 cts.

One-ply of cloth to every 1-16 inch thickness.
Three cents per pound additional will be charged for each extra ply of cloth. Each cloth, whether insertion or on outside, to count as one ply.
All cloth insertion or plain packing is one yard wide, and any length desired.
Wire insertion packing, all thicknesses, per lb, 50 cents.
Discounts: B 2, 70 & 10; A, 60, 10 & 10; AA, 60 per cent.

GASKETS.

Corrugated Copper.

Price, 2 cents per square inch, less 30 per cent. discount for home trade.
Less 60% discount for export trade.

Bolts.
Philadelphia Tire Bolt, with forged nuts.
Price per hundred.
Condensed list.

Length	1-8	3-16	7-32	1-4	5-16	3-8
1	$1·50	$1.50	$1.50	.....	.....	.....
2	1·50	1.60	1.85	$2.25	$3.05	$5.00
3	.....	1.90	2.25	2.75	3.65	5.80
4	.....	.....	.....	3.25	4.25	6.60
5	.....	.....	.....	.....	4.90	7.40

Fractional sizes, intermediate prices.
Discount 80 and 25 %.

Common Carriage Bolts, price per hundred.

Length.	3-16 & 1-4	5-16	3-8	7-16	1-2	9-16 & 5-8	3-4
1 to 1½	$1.35	$1.60	$2.30	$3.10	$3.80	$7.50	
2	1.45	1.75	2.30	3.10	3.80	7.50	
3	1.65	2.05	2.70	3.60	4.44	7.50	$13.50
4	1.85	2.35	3.10	4.10	5.08	8.50	14.90
5	2.05	2.65	3.50	4.60	5.72	9.50	16.30
6	2.25	2.95	3.90	5.10	6.36	10.50	17.70
7	2.45	3.25	4.30	5.60	7.00	11.50	19.10
8	2.65	3.55	4.70	6.10	7.64	12.50	20.50
9	2.85	3.85	5.10	6.60	8.28	13.50	21.90
10	3.05	4.15	5.50	7.10	8.92	14.50	23.30
12	3.45	4.75	6.30	8.10	10.20	16.50	26.10
14	3.85	5.35	7.10	9.10	11.48	18.50	28.90
16	4.25	5.95	7.90	10.10	12.76	20.50	31.70

Fractional sizes, intermediate prices.
Discount 75 and 10%.

Philadelphia Carriage Bolt, price per hundred.

Length	1-8, 3-16 & 1-4	5-16	3-8	7-16	1-2
1 inch.	$3.00	$4.00	$5.00	$7.40	$9.00
2 "	3.40	4.10	5.00	7.40	9.00
3 "	3.80	4.70	5.80	8.20	10.00
4 "	4.20	5.30	6.60	9.00	11.00
5 "	4.80	6.00	7.40	9.80	12.00
6 "	5.40	6.60	8.20	10.60	13.00
7 "	.....	7.30	9.00	11.40	14.00
8 "	.....	7.90	9.80	12.20	15.00
9 "	.....	8.50	10.60	13.00	16.00
10 "	.....	.....	11.40	13.80	17.00
11 "	.....	.....	.....	14.60	18.00

Fractional sizes, intermediate prices.
Discount 80 and 5 %.

Can Openers.

	Gross.		Doz.
American	$3.00	Eureka	$2.50 10 % dis.
Duplex	2.70 20 % dis.	Domestic	2.50 45 % dis.

Carpet Sweepers.

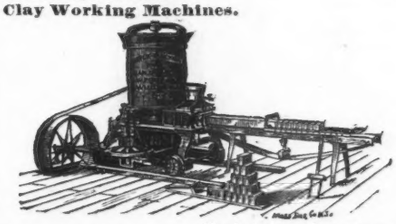
	Per doz.
Bissell's, No. 5	$17.00
" New drop pan, No. 7	19.00
" Grand	36.00
" Superior	
Grand Rapids	24.00
Magic	15.00

Cigarettes (all tobacco).

Liberty Bell (small cigars)	$6.00 per 1000
Golden Giants (regular shape)	7.00 " "

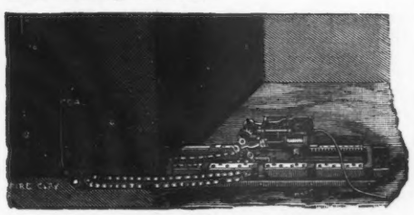
Net f. o. b., New York.

Clay Working Machines.



	No. brick per day.	Compl'te.
No. 10 D brick machine	50,000	$1,500
No. 10 S " "	30,000	1,200
No. 4 " "	40,000	1,100
No. 7 S " "	20,000	650
No. 6 S " "	15,000	575
No. 2 E. H. P. "	6,000	3,360

Coal Mining Machine.



Jeffery.
6 feet undercut.....$1500 | 5 feet undercut.....$1400
Jeffery Power Coal Drills.
Air feed drill.....$275 | Screw feed drill.....$200
Discount, 10%.

Cork Pullers.

The Samson Cork Puller, per dozen, $12 net.

Crucibles.

E. H. Sargent & Co.
Battersea Crucibles, Triangular.

No.	Height. Inches.	Width. Inches.	Crucibles. Per doz.	Covers. Per doz.
S	4½	4½	$1.00	$0.50
T	4	3¾	0.80	0.50
U	3½	3¼	0.60	0.40
V	3¼	2⅞	0.45	0.40
W	2⅞	2⅝	0.35	0.30
X	2½	2¼	0.30	0.30
Y	2⅛	2⅛	0.25	0.30
Z	1¾	1¾	0.20	0.30

Battersea Muffles, any size, made to order.
See Illustration in advertisement.

No.	Long. Inches.	Wide. Inches.	High. Inches.	Price. Each.
A	7	3½	2½	$ .60
B	7½	4⅛	2⅞	.75
C	8	4¾	3	.85
D	8½	5	3¼	1.00
E	9	5½	3⅝	1.15
F	10	6	4	1.25
G	11	4	3½	1.00
H	10½	5¼	3⅝	1.00
J	12	6	4	1.25
K	14	8	5	1.75
L	15	9	6	2.00

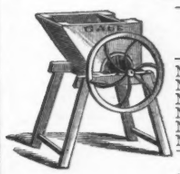
Export discount .15 %.

Cutters. FEED.

No. of cutter.	No. of knives.	Length in inches of knives.	Length in inches of feed cut.	Price.
1	2	6¼	½, ¾ and 1⅛	$18.00
2	2	7¼	⅛, ¾ and 1⅞	21.00
2½	1	7¼	⅝, ⅞, 1¼ and 1¾	21.00
2½	2	7¼	⅛, ⅛, ⅝ and ⅞	23.00
3	1	8½	⅝, ⅞, 1¼ and 1¾	25.00
3	2	8½	⅛, ⅛, ⅝ and ⅞	27.00
4	1	10	⅝, ⅞, 1¼ and 1¾	30.00
4	2	10	⅛, ⅛, ⅝ and ⅞	33.00
5	2	10	⅛, ⅛, ⅞ and 1¼	35.00
6	2	11	⅛, ¾, 1¼ and 2	45.00
6½	2	11	⅛, ¾, 1¼ and 2	45.00
7	2	13	⅛, ¾, 1¼ and 2	60.00
7½	2	13	⅛, ¾, 1¼ and 2	60.00
10	2	16	⅛, ¾, 1¼ and 2	80.00
12	2	20	⅛, ¾, 1¼ and 2	100.00
11	2	11	⅛, ¾, 1¼ and 2	45.00
13	2	13	⅛, ¾, 1¼ and 2	60.00
16	2	16	⅛, ¾, 1¼ and 2	80.00
20	2	20	⅛, ¾, 1¼ and 2	100.00

The knife arbors for all sizes are made of machinery steel. 30 per cent. dis.

VEGETABLE—GALE'S.



Size.	Weight of Fly Wheel. Pounds.	Will cut per hour. Pounds.	Price
No. 1½	20	1,500	$12
No. 2½	32	1,700	15
No. 3½	32	1,700	15
No. 4	42	2,000	18
No. 5	50	3,000	25
No. 10	65	8,000	35

30% dis.

Duck and Twine.

Baltimore T. & N. Co.—22-inch, Hard, Medium and Soft.

	Weight per yd.	Cents, per yd.		Weight per yd.	Cents, per yd.
No. 0	19 oz.	35	No. 6	13 oz.	26
1	18 "	33	7	12 "	25
2	17 "	32	8	11 "	23
3	16 "	30	9	10 "	21
4	15 "	28	10	9 "	20
5	14 "	27			

Ravens, 28½-inch.

	Cents, per yd.		Cents, per yd.
Eight ounce	15	Twelve ounce	22
Ten "	19	Fifteen "	27

Dis. 25 and 1%.
Cotton Sail Twine.
Three-fold and upward, 17 to 20 cents per pound.
Dis. 3%.

Egg Beaters.

Dover	Per doz. $2.00	H. & R. Mfg. Co.	
Standard Co.		Double	Per gross, $16.20
Kingston	Per gross, $6.50	Triple	" 16.20
Acme	" 6.00	Easy	" 14.00
Rival	" 12.00	Spiral	" 4.50
Duplex	" 15.00	Paine, Diehl & Co., p.g.	24.00

Dis. — —.

Electroplate.—Babcock & Co.'s.

CASTERS.

1,200—Dinner.

232—Breakfast.

Dinner Casters.

No. 1,200. 17½ in. high, $8.00, quadruple plate.
No. 80. 17 in., $6.00, quadruple plate.
No. 140. 16 in., $7.50, " "
No. 830. 16 in., $5.00, " " Plain, 50 cents less.
No. 25. 16 in., $4.00, double plate.
No. 33. 16 in., $3.75, " "
No. 53. 15 in., $3.00, " "
No. 15½. 14½ in., $2.00, single plate.
No. 19. 14½ in., $1.85, " "
No. 40. 14 in., $1.75, " "

Breakfast Casters.

No. 231. 10 in. high, $4.00, quadruple plate.
No. 232. 12 in. high, $6.00, quadruple plate.
No. 13. 12 in. high, $2.25, double plate.
No. 12. 10½ in. high, $1.75, single plate.

No. 681.

CAKE BASKETS.

Quadruple Plate.

No. 448. 7 in. high-chased, $16; gold lined, $17.
No. 690. 7½ in. high, chased, $7; gold lined, $8.
No. 686. 6½ in. high-chased, $4.50; gold lined, $5.50.
No. 681. 6 in. high, chased, $3; gold lined, $3.50.

BUTTER DISHES.

No. 126. 11 inches high, $5.50.
No. 127. 7 inches high, $5.50.
No. 75. 8 inches high, $1.85.
No. 78. 7½ inches high, $2.00.
Di 60 and 2½ per cent.

CHILD'S SETS.

No. 90.

No. 90. Satin-lined case, cup, saucer, knife, fork and spoon, $2.25.
No. 41. Cup, gold lined, in fancy case, $1.15.
No. 43. Cup and saucer, gold-lined, fancy case, $1.15.

FLAT WARE.

Calla Lily, Empress, Windsor and Olive Patterns, 18 Per Cent Nickel Silver Base.

	Extra plate, per doz.	Double plate, per doz.	Triple plate, per doz.
Tea spoons	$4.75	$6.00	$7.25
Dessert spoons	8.50	10.50	12.50
Table spoons	9.50	12.50	14.50
French coffee spoons	4.75	6.00	7.25
Berry or nut spoons	24.00	30.00	36.00
Bar spoons, small	4.75	6.00	7.25
Dessert forks	8.50	10.50	12.50
Medium forks	9.50	12.00	14.50
Oyster forks	7.00	9.00	11.00
Sugar shells	9.00	11.00	13.00
Sugar tongs	25.50	31.50	37.50
Butter knives, twist or reversed handles	10.50	12.50	14.50
Nut picks	4.75	6.00	7.25
Pie knives, engraved blades	42.00	51.00	60.00
Soup ladles	48.00	60.00	72.00

PICKLE DISHES.

No. 146.

No. 144. 12 in. high, $3.50.
No. 66. 10½ in. high., $2; assorted colored glass.
No. 155. 12 in. high, $4; assorted colored glass.
No. 146. 12½ in. high, $9; hand decorated glass.
No. 156. 12½ in. high, $6; hand decorated glass.

TEA SETS.

No. 255.

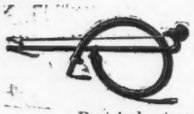
No. 255. 6 pieces, $35, quadruple plate.
No. 301. 4 pieces, $23, quadruple plate.
No. 1847. 6 pieces, $42, quadruple plate.

ICE PITCHERS.

No. 754.

No. 754. 21 in. high, double wall, $30, quadruple plate.
No. 640. 12½ in. high, double wall, $15, quadruple plate.
No. 751. 12½ in. high, single wall, $6, double plate.

Flue Cleaner.
Hurley's Automatic Steam Flue Cleaner.



No.	Outside diam. of tubes.	With hose clamps.	Globe Valves.	Best 4-ply steam hose. Per foot.
1	1½ to 2	$5.00	½, 95 cents	¾, 67 cents.
2	2 to 2½	6.25	½, 95 cents	¾, 67 cents.
3	2½ to 3	7.50	¾, $1.30	¾, 67 cents.
4	3 to 3½	8.75	1, 1.75	1¼, 83 cents.
5	3½ to 4½	10.00	1¼ 2.90	1¼, $1.04

Dis. on flue cleaners, 60 and 70%.
Dis. on steam hose, 50%, good to 90 lbs steam.

Flouring Mill Machinery.
Nordyke & Marmon Co.

Roller Mills for Wheat Flour.

Prices of Double and Single Roller Mills.

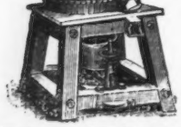
Size.	All smooth.	½ Corrug. ½ smooth.	All corrug.	Single machines. Corrug.	Smooth.
6×12	$465	$475	$480	.....	.....
6×16	515	525	530	.....	.....
6×20	565	575	580	.....	.....
7×14	515	525	530	.....	.....
7×18	560	570	575	.....	.....
7×24	635	645	650	.....	.....
9×18	625	640	650	$350	$335
9×24	700	720	735	390	375
9×30	785	810	830	440	420

20-inch New Era Mill for Wheat, Corn, and Middlings.

Size. Inch.	Power. H. P.	Pulley. Inch.	Capacity Bush.
20	4 to 10	14×7	12 to 40

Speed. Weight. Price.
Lbs.
500 to 800 660 $150

The Nordyke Bradford Portable Mill.



Size of stones, In.	Grinding capacity. Corn, bu. per hour.	Wheat bu. per hour.	Horse-power.	Weights. Sing'l gear.	Double gear.	Pulley mill.	Geared mills. Iron wh'ls.	Mortise wh'ls.
18	8 to 10	.....	4	550	625	$130	$165	$180
20	10 to 12	.....	5	600	700	140	175	190
22	12 to 15	.....	5	700	850	160	190	210
24	15 to 18	.....	6	900	1050	175	210	225
26	18 to 20	8 to 10	8	1200	1400	185	225	250
30	20 to 25	10 to 12	10	1500	1700	225	255	290
36	25 to 30	14 to 17	12	1800	2100	315	355	380
42	35 to 40	19 to 21	15	2000	2300	390	435	460

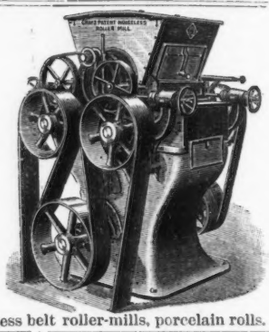
Farm and Plantations Mills.

Diameter of burrs.	Power to drive.	Size of pulley.	Capacity per hour.	Revolutions per minute.	Weight.	Price.
	H. P.					
14 in.	2 to 4	9×5½	4 to 14 bushels	600 to 1200	370 lbs.	$10 0
18 in.	4 to 10	11×6½	8 to 40 bushels	400 to 700	600 lbs.	13 0

The Dixey Mill—Stiff Spindle Style.

Size.	Power.	Capacity.	Weight. Pulley.	Geared	Pulley.	Iron gear.	Mortise gear.
18	4 to 6 H.P.	8 to 25 bu	560 lbs	650	$130	$165	$180
22	6 to 8 "	12 to 30 "	800 "	1000	165	200	225
26	8 to 12 "	16 to 40 "	1100 "	1500	185	220	245
30	10 to 15 "	25 to 60 "	1300 "	1700	215	255	280

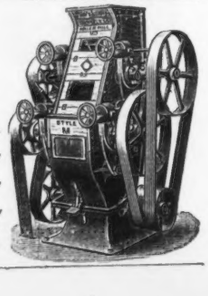
Flour Mills.
E. P. Allis & Co.



Gray's pat. noiseless belt roller-mills, porcelain rolls.

Size of Rolls.	Height.	Width.	Length.	Driving pulley.	Revolutions per minute.	Approximate power required.	Length of driving belt above floor.	Approximate shipping weight.	Price.
14" × 16" single	5' 7"	3' 2"	5'	20" × 6½"	200 to 300	1¾ to 2½ H. P.	16' 3"	2,700 lbs.	$800.00
14" × 16" double	5' 10"	5' 6"	4' 10"	20" × 6½"	200 " 300	3 " 4 "	19 3"	4,000 "	800.00
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 " 400	1½ " 2½ "	16' 6"	2,700 "	580.00
With corrugated chilled iron rolls.									
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$800.00
With Wegmann's patent porcelain rolls.									
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$650.00
Divided four roller machines.									
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$680.00
1-pr. cor. 1-pr. sm.	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	615.00
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	625.00
1-pr. sm. 1-pr. por.									
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	
1-pr. cor. 1-pr. por.									

For grinding corn, feed, rye, etc,



Size.	Height.	Width.	Length.
6" × 12"	4' 6"	3' 5"	2' 7"
9" × 14"	5' 8"	3' 10"	3' 5"
9" × 18"	5' 8"	4' 9"	3' 5"
9" × 24"	5' 8"	5' 6"	3'

Driving pulley.	Revolutions per minute.	Length of belt above floor.	Approximate shipping weight.	Price.
10″ × 5¼″	400 to 500	14′	.....	$500.00
14″ × 6¼″	350 to 450	18′	2600 lb.	600.00
14″ × 7¼″	350 to 450	18′	3050 lb.	650.00
14″ × 8¼″	350 to 450	18′	3350 lb.	735.00

Forges (Portable).

Fairbanks.

No. 2c, weight, 155 lbs. 21 × 27 hearth.....$42.00
" 3a, " 80 " 18 in. diam. hearth..... 27.00
" 3b, " 75 " 18 " " " 24.00
" 3c, " 85 " 18 " " " 30.00
" 6a, " 45 " 14 " " " 18.00
" 6B, " 45 " 14 " " " 16.00

Dis. 60%.

Bullock's (Portable.)

No. 1, 18 in. bellows, $20; No. 2, 20 in. bellows, 25; No. 3, 22 in. bellows, $30.

20% dis.

Stationary.

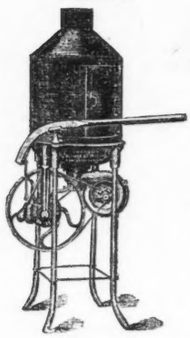
27 in. bellows, $21; 30 in. bellows, $25; 33 in. bellows, $33; 36 in. bellows, $45.

20% dis.

Riveting Forges.

Bellows, 18 in., 20 in., 22 in., 24 in., $8.00. $10.00. $13.00. $17.00.

20 % dis.



Empire.

Light work, 12 × 17; height, 15 in., $16.00.

Same, with Hood, 12 × 17; height, 28 in., $20.00.

Bridge, Boiler or Railroad work, Pan, 17 × 19; height, 29 in.; Fan, 8 in., $27.00.

Same, with Hood, $30.00.

Water Tank, $4.00 extra.

Iron Fire Ring Round Tuyere, $1.00 extra.

50 % dis., f.o.b. at Cohoes.

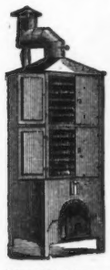
Fruit Evaporator.

No. 1. Evaporator..... $30
No. 2. Fruit Drier and Baker, with Bleacher attachment. Weight, 225 lbs. Capacity, 5 to 7 bushels apples per day; 24 in. deep, 26 in. wide, 5½ ft. high; 12 trays, 22 22; 40 square feet drying surface. Complete..... $50
No. 3. Capacity, 15 to 20 bushels per day..... 100
No. 4. Capacity, 20 to 30 bushels per day..... 16

Dis., No. 1, 3 and 4 = 20%.
" 2 = 30%

Boxing, extra:
No. 1, $3.00; No. 2, $5.00; No. 3, $7.50; No. 4, $12.50.

Freight to New York:
No. 1, $4.00; No. 2, $6.00; No. 3, $12.00; No. 4, $18.00.



Fruit Presses.

P., D. & Co. .....per doz., $4.50

Glass Tube Cutters.

One Arm Carries Rotary Cutter, Price, $2.50 each.

Glassware.

6-in. bowl and cover, per doz.....$3.25
7-in. " " " 4.50
8-in. " " " 6.00
9-in. " " " 8.00
10-in. " " " 10.50

Net.

Nappy, 4½-inch., per doz., 50c.; 6-inch., per doz., $2; 7-inch., per doz., $3; 8-inch., per doz., $4.

Cream Pitcher, 1 pint, per doz., $1.25; one quart, per doz., $3.50; 3 pints, per doz., $4.50.

Pint Pitcher, per doz., $1.50; quart pitcher, per doz., $2; ½ gallon pitcher, per doz., $3; 3 quart pitcher, per oz., $4.50.

Flange Butter and Cover, per doz., $1.75.
Water Set, per doz., sets of 60 pieces, $7.50.

Cheese Dish and Cover, 8 in., per doz., $4.50.

Quart Water Bottle, per doz., $4.50.

Ind. Salts; per gross, $2.00. Assorted patterns.
4 Bottle Castors, per doz., $7.50; 3 bottle, per doz., $4.50.

Berry Dish, 4½-inch, per doz., 50c.; 10-inch, per doz., $4.
Butter Dish and Cover, per doz., $1.25.
Butter Dish and Cover, per doz., 75c.

Candlesticks, per doz., $2.00. Glass Slipper for Flowers, per doz., 50 cents; slipper and tray, per doz., $1. Jam Jar and Cover, 1 qt., per doz., $2.50; ½ gal., per doz., $3.25; ¾ gal., per doz., $4; 1 gal., per doz., $5; 1½ gals., $9; 2 gals., per doz., $12. Pocket Flask, 1 pint, $1.

Tumblers.

1½ oz., per doz., 50 cents.
8 " " 75

9 oz., per doz., $2.75.

11 oz., assorted patterns, per doz., 30 cts.

9½ oz., assorted patterns, per doz., 25 cts.

1 oz. to 12 oz., nested for shipping, per doz. nest, $2.

Goblets, banded, per doz., 65 cents.
Claret to match, per doz., 55 cents.
Wines, to match, per doz., 50 cents.
Cordials, to match, per 45 cents.

Banded, open, hollow stem.

Goblets, per doz., 50 cts.
Claret, " 50 "
Wine, " 35 "

Champagne, per doz., $1.25.

½ Pt. tumbler, per doz..55 cts.
½ Pt. mug to match, " ..65 "
Goblet, " " ..50 "
Spoon holder, cream pitcher, sugar, butter dish to match.
Sets of 4 pieces, per doz. sets, 48 pieces, $3.75.

Hammers.

H. Cheney Hammer Co.

Adz-eye Hammers.—Per Dozen.

No.	Weight.		No.	Weight.	
5.	Round. 1 lb., 4 oz	$9.00	7½.	Round. 13 oz...	$8.00
7.	" 1 lb.....	8.50	8	" 7 oz....	7.50

Adz-eye Hammers.—Per Dozen.

No. 17. Octagon. weight, 1 lb., 4 oz.....$9.00

Adz-eye Hammers.—Patent Nail Holder.—Per Dozen.

No.	Weight.		No.	Weight.	
33.	Bell-face. 1 lb., 4 oz.	$9.50	35.	Round h. 1 lb., 4 oz.	$9.50
34.	" 1 lb.....	9.00	36.	" 1 lb.....	9.00

Adz-eye Hammers.—Bell Face.—Per Dozen.

No.	Weight.		No.	Weight.	
37.	1 lb., 4 oz.....	$9.00	38½.	13 oz.....	$8.00
38.	1 lb.....	8.50	39½.	7 oz.....	7.50

Farriers' Hammers.—Per Dozen.

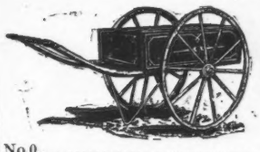
No.		Weight.	
55.	Adz-eye. Octagon.	9 oz.....	$7.75
56.	" "	7 oz.....	7.50
57.	Plain. "	7 oz.....	6 25
58.	Plain Brad.	4 oz.....	5 50
60.	Adz-eye, Round Head.	7 oz.....	7 50
61.	" Octagon. Boston pattern	10 oz.....	8.00
62.	" " "	7 oz.....	7.50

Machinists' Ball Pein Hammers.—Octagon.—Per Dozen.

No.	Weight.		No.	Weight.	
90.	3 lbs.....	$22.00	94.	1 lb., 4 oz.....	$13.50
90½.	3 lbs., 8 oz.....	19.00	95.	1 lb.....	12.50
91.	4 lbs., 4 oz	17.50	96.	12 oz.....	12.00
92.	2 lbs.....	16.50	97.	8 oz.....	12.00
92½.	1 lb., 12 oz.....	15.50	98.	6 oz.....	12.00
93.	1 lb., 8 oz ...	14.50			

Discount, 35 and 5 per cent. Net Cash, 30 days. 10 per cent. Cash, 10 days. Cases at Cost.

Hand Carts No. 0, 42 wheel, 1 in. tread, 1 in. axle box 48x28x10 deep $10.50.



No. 1, 36 wheel, 1 in. tread, ⅞ in. axle, box 40x23x10 deep, $9.00.

No. 2, 30 wheel, ¾ in tread, ¾ in. axle, box 32x20x9 deep, $8.25.

With Wagon-Seat Spring.

No. 6, same sizes as

No 0.....$12.00
" 7, same sizes as No. 1..... 10.50
" 8, " " " No. 2..... 9.75

With Third Wheel, Without Springs.

No. 3, same sizes as No. 0.....$12.00
" 4, " " " No. 1..... 10.50
" 5, " " " No. 2..... 9.5

Handles.

	Doz.
Extra, Axe 36-inch	$1.90
No. 1 $1.50 | No 2	1.10
Extra, Axe, Boys, 26 and 28 inch	1.25
No. 1 $1.15 | No. 2	85
Extra, Axe, Broad or Squaring	2.00
No. 1 $1.50 | No. 2	1.25
Extra, Adz Colonial, Ship and R. R., 34 and 32-inch.	2.00
No. 1 $1.60 | No. 2	1.25
Extra, Pick R. R., 36-inch	2.00
No. 1 $1.40 | No. 2	1.10
Extra, Pick Square Eye Miners' 34, 33 and 32-inch. Extra, Square Eye Driving 34, 33 and 32-inch.	2.00
No. 1 $1.50 | No. 2	1.25
Extra, Pick Square or Oval Eye Miners' or Drifting Pick, 34 and 32-inch	2.00
No. 1 $1.45 | No. 2	1.20

Sledge Hammer, Tool, Maul, Straight Taper.

	Extra.		Extra.
24-in..... No. 1, $ 65;	$ 80	34-in..... No. 1, $ 95;	$1.10
26-in..... No. 1 75;	90	36-in..... No. 1, 1.05;	1.20
28-in..... No. 1, 80;	95	38-in..... No. 1, 1.15;	1.30
30-in..... No. 1, 85;	1.00	40-in..... No. 1, 1.35;	1.40
32-in..... No. 1, 90;	1.05	42-in..... No. 1, 1.60;	1.75

Blacksmith Hammer, Machinist Hammer, Hand Hammer.

Per. doz. Extra.		Per doz. Extra.	
14-in..... No. 1, 35c.;	45c.	20-in..... No. 1, 65c.;	75c.
16-in..... No. 1, 45c.;	55c.	22-in..... No. 1, 70c.;	80c.
18-in..... No. 1, 55c.;	65c.	24-in..... No. 1, 75c.;	85c.

Adze Eye and Round Eye Hammer, 12, 13, 14, 15 in., per doz..... 30c.

Shingling and Lath Hatchet, 12, 13, 14, 15 in., per doz. 30c.

Broad Hatchet.

Per doz.		Per doz.	
16-in	50c.	18-in	55c.
17-in	50c.	19-in	55c.

Dis., 10.10 and 2 %.

Hardware Specialties.

AUGERS.

Patent Adjustable Hollow.

Cuts from ¼ to 1¼, pivoted jaws, graduated scale to 1-16ths, per doz., $60.00.

Discount, 15 and 10%.

Patent Hollow Auger.

Inch.....	5-16	⅜	7-16	½
With bits....	12.00	12.00	12.00	12.00
Without bits	8.00	8.00	8.00	8.00
9-16	⅝	¾	⅞	1
14.00	14.00	14.00	16.00	20.00
9.00	9.00	9.00	13.00	13.00
1¼	1⅜	1½		
20.00	24.00	24.00		
14.00	16.00	15.00		

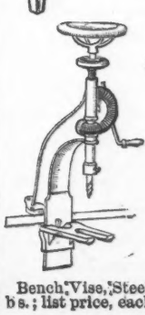
Discount, 15 and 10%.

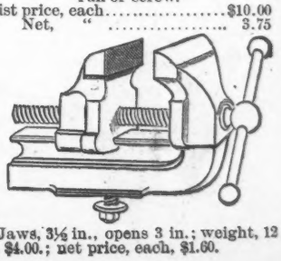
BENCH DRILL.

Adjustable bed plate.

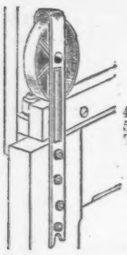
26½ high drills to ½ in. hole, 3½ in. run of screw.

List price, each.....$10.00
Net, " 3.75



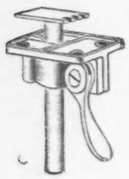


Bench Vise, Steel Jaws, 3½ in., opens 3 in.; weight, 12 lbs.; list price, each, $4.00.; net price, each, $1.60.



BARN DOOR HANGER.

4 in., per doz. pairs.....$12.00
5 " " " 14.40
Track, per foot..... .08
One dozen pairs in case.
Dis., 50%.



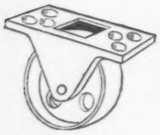
BENCH HOOK.
Patent, adjustable and reversible.
List $9 dozen, ½ dozen in box.
Discount, 20 and 10%.

BLACKSMITH'S TONGS.
Swivel Jaw.

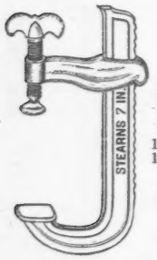
No. 1, 16 in., per doz.....$10.00
" 2, 18 " " 10.00
Dis. 20%.

CASTERS.
Swivel Store Truck.

No. 20, japanned, 4 in. wheel, each..... .55
No. 25, " 5 " " " ..... .75
Noiseless turned wheel.
No. 30, japanned, 4 in. wheel, each..... 1.30
No. 35, " 5 " " " 1.60
Discount, 25%.



Store Truck, stationary.
No. 50, 5-inch wheel, 1¼ inch wide, each, $1.05.
No. 60, 5-inch, extra heavy, 1½ inch wide, each $1.50.
Discount, 25%.

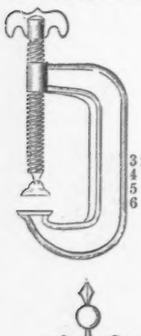


SCREW CLAMPS.
Adjustable.

3 in., per doz.....$4.00
5 " " 6.50
7 " " 9.00
9 " " 10.50
12 " " 15.00
16 " " 20.00

½ doz. in box.
Discount, 20 and 10%.

CLAMPS.
New Door Frame.
3 ft. long, per doz., $8 list; $5 per doz. net.



Malleable Iron Screw Clamps.

Per Doz.		Per Doz.	
3 in.	$7.00	7 in.	$20.00
4 "	10.00	8 "	25.00
5 "	12.00	9 "	27.50
6 "	16.00	10 "	30.00

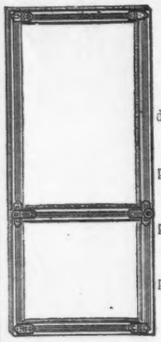
3, 4, 5, 6 in., ½ doz. in box.
Dis., 70%.

CLOTHES REEL.
Extra heavy, gray iron, japanned.
List per doz.....$15.00
Net " 7.00

JACK SCREWS.
New pattern wrought iron screw.

No.	Rise of screw.	High.	Diameter screw.	Price.
20	4½ in.	10 in.	2 in.	$4.50
25	6½ "	12 "	2 "	5.25
30	8½ "	14 "	2 "	5.75
35	11½ "	16 "	2 "	6.50

Discount, 40%.



DOOR SCREEN FRAMES.
Patent Corners.

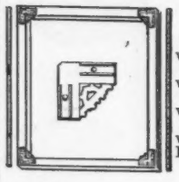
No. 22, 3 by 7 ft. sticks, ⅞ by 2, per doz. sets, $11.

No. 24, 3½ by 8 ft. sticks, ⅞ by 2, per doz. sets, $12.

No. 26, 3 by 7 ft. sticks, ⅞ by 2½, per doz. sets, $12.50.

No. 28, 3½ by 8 ft. sticks, ⅞ by 2½, per doz. sets, $14.50.

Dis., 20%.

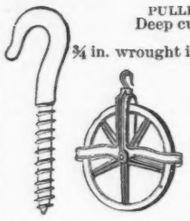


WINDOW SCREEN FRAMES.
Patent Japanned Corners.
No. 25, 36 by 36 corners and screws, without bead, per doz., $2.50.
No. 25, 36 by 36 corners and screws, with bead, per doz., $2.90.
No. 35, 42 by 42 corners and screws, without bead, per doz., $2.90.
No. 35, 42 by 42 corners and screws, with bead, per doz., $3.30.
Black satin stain, sticks ⅞ by 1 in.
Dis., 20%.

PULLEYS.
Side, No. 45, Japanned.

Inches...	1	1½	2	2½	3	4	5
Per doz..	.90	1.00	1.60	2.40	3.50	9.00	15.00

2 inch and under, 2 dozen in box: 2½, 3 and 4, 1 dozen in box; 5 inch, ½ dozen in box.
Discount, 50%.



PULLEY HOOK (New Floor.)
Deep cut thread, forged point.

	Per doz.
¾ in. wrought iron, 8 in. long, list.....	$1.90
net.....	1.00

WELL WHEEL.
New pattern.
Japanned.

In.	8	10	12	14	16
Prd.	7.00	9.50	12.50	20.00	30.00

Discount, 70%.

HAY FORK PULLEY.
New pattern.

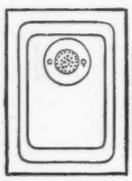
No. 15, 5 in. iron wheel.....per doz. $4.50
25, 5 in. wood " ..... " 4.50
66, 6 in. " ..... " 6.00

4 dozen in case, 8 dozen in barrel.

No. 15, per dozen, $2 net.

SHEAVES.
Patent Common
Turned and polished iron wheels, round corners, brass pin, one set in box.

2½ inch $1.50
3 " 1.60
4 " 2.00
5 " 2.60
Discount, 50%.



SINKS.
All 6 inch deep.

14 × 20 in....	$1.50	18 × 30 in....	$2.50
15 × 25 in....	1.75	18 × 32 in....	3.00
15 × 27 in....	2.00	18 × 36 in....	3.00
16 × 24 in....	1.80	20 × 30 in....	3.00
16 × 28 in....	2.10	20 × 36 in....	3.70
17 × 30 in....	2.25	20 × 40 in....	4.00
18 × 24 in....	2.10		

Discount, 60%.

SPOKE POINTERS.

	Per doz.
No. 1, points 1⅞ in. diameter,	$9.00
No. 2, points 2⅝ in. diameter,	$15.00

Discount, 15 and 10%.

½ dozen in box.

VISE.
(Bench Vise, Steel Jaws.)
3½ in. opens 5 in., weight 12 lbs.
List price, each.$4.00
Net " " .. 1.60

Silent Saw Vise.
No. 10., 10 in. jaw, per doz....$15.00
Dis., 33⅓%.

Moore & Barnet Mfg. Co.

No.	per dz.	gr., lbs.	No.	per dz.	gr., lbs.
1	Amateur vise.....	$2.25	70	Clamp.	
	Anvil.			1½.....	3.00	80
2	.....	3.75	200	2½.....	5.00	220
3	.....	11.25	615	3½.....	14.25	700
4	.....	18.00	1,350	4½.....	21.00	1,425
10	.....	24.00	1,675	Combination hand.....	5.25	85

Spot cash discount, 33, 20 and 2, f.o.b.
Nos. 1, 1½, 2 and 2½ are packed in dozens; Nos. 3 and 3½ in half dozens; Nos. 4, 4½ and 10 in quarter dozens, and No. 20 singly. Each hand vise is put up in neat box and packed in half dozen lots.

1 Hinge pipe vise, 0 to 2 in. pipe.....Each $10.00
2 " " " 0 to 4 in. pipe..... 20.00
1 Malleable pipe vise, 0 to 2 in. pipe..... 8.00
1 Combination pipe and bench vise, 0 to 2 in. pipe...16.00
Discount, 50%.

WRENCHES.
Coes' Knife Handle Wrenches.

BLACK.

Size.	₱ doz.	Size.	₱ doz.
6 inch.....	$9.00	15 inch.....	$24.00
8 "	10.00	18 "	30.00
10 "	12.00	21 "	36.00
12 "	14.00		

BRIGHT.

4 inch.....	$10.00	12 inch.....	$16.00
6 "	10.00	15 "	26.00
8 "	11.00	18 "	32.00
10 "	14.00	21 "	38.00

Discount, 55, 10, 7½ and 3 %.
Coes Mechanics' Screw Wrenches, same list, less 55, 10, 10, 7½ and 3 %.
A. G. Coes & Co. Pat. Screw Wrenches, same list as above. Discount, 55, 10, 7½ and 3%.

Hose.

Improved "Smooth Bore" Rubber Suction Hose.
On spiral flat or round tinned steel wire.

Int. Diam.	Per ft.
2 inch.....	$2.60
2½ "	3.50
3 "	4.00
3½ "	5.50

In. Diam.	Per ft.	Per. Diam.	Per ft.
4 inch.....	6.50	7 inch.....	$13.50
4½ "	7.50	7½ "	15.00
5 "	8.50	8 "	16.50
5½ "	9.50	9 "	19.50
6 "	10.50	10 "	22.50
6½ "	12.00	12 "	27.50

Suction hose discount, high grade, 50 and 10%; Royal, 60, 10 and 5%; Manhattan, 70 and 5%.

Suction Hose.
On spiral brass or iron wire.

Int. Diam.	Per. ft.
¾ inch.....	$ .77
1 "	1.00
1¼ "	1.25
1½ "	1.65
1¾ "	2.10
2 "	2.50

Rubber Hose.
Conducting Hose—Two-ply.

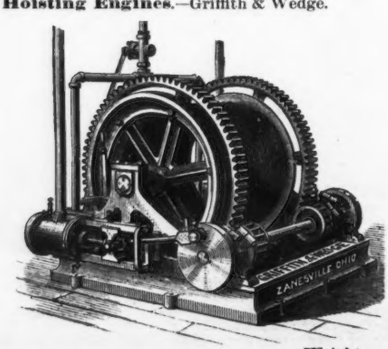
Int. diam.	Per ft.	Int. diam.	Per ft.	Int. diam.	Per ft.
½ in.....	$0.20	2 in.....	$0.66	5 in.....	$1.65
¾ in.....	25	2¼ in.....	75	6 in.....	1.98
1 in.....	33	2½ in.....	83	7 in.....	2.31
1¼ in.....	42	2¾ in.....	92	8 in.....	2.64
1½ in.....	50	3 in.....	99	9 in.....	2.97
1¾ in.....	58	4 in.....	1.32	10 in.....	3.33

Hydrant Hose—Three-ply.

½ in.....	$0.25	1½ in.....	$0.60	2½ in.....	$1.00
¾ in.....	30	1¾ in.....	70	2¾ in.....	1.10
1 in.....	40	2 in.....	80	3 in.....	1.20
1¼ in.....	60	2¼ in.....	90	3½ in.....	1.40
				4 in.....	1.60

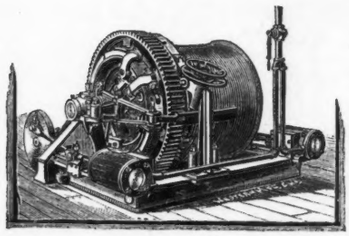
Discount—High grade, 60; Royal, 70; Manhattan, 70 and 10 per cent.

Hoisting Engines.—Griffith & Wedge.



	Weight.	$
Hoisting Engines, Miner's Prospecting.....	4,500	750

		Weight.	$
Hoisting Engines, No. 1 Double Cylinder...		4,500	800
Discount, 20%.			
" " No. 2 Double Cylinder...		6,000	1,000
" " No. 3 " " ...		11,000	1,550
" " No. 4 " " ...		15,500	1,800
" " No. 5 " " ...		17,000	2,100
" " No. 6 " " ...		13,600	1,750
" " No. 7 " " ...		17,000	2,100
" " No. 8 " " ...		19,000	2,400
" " No. 9 " " ...		48,000	4,500
Discount, 25%.			



Webster, Camp & Lane Machine Co.

Double Cylinder Portable Hoist.

Double drum. Approx. weight, complete			Pounds.	6,000	6,500	8,000	8,500	14,000	16,000	19,000	22,000
								$1,661.00	1,815.00	3,124.00	3,333.00	3,872.00
Average Load			Pounds.	1,950	1,650	2,200	3,000	3,500	3,700	5,500	5,500
Average speed of hoist			Feet.	250	300	300	325	350	350	375	400
Pitch of groove			Inches.	¾	¾	13/16	13/16	15/16	15/16	1⅛	1⅛
Diameter rope			Inches.	⅝	⅝	⅝	13/16	13/16	1	1	1
Drum.	Capacity		Feet.	380	460	540	540	600	770	675	900
	Face		Inches.	36	36	36	36	42	48	48	60
	Diameter		Inches.	30	36	42	42	48	54	60	66
Gears.	Face		Inches.	5	5	6	6	7	8	8	8
	Pitch		Inches.	1¾	1¾	1¾	1¾	2⅛	2⅜	2⅜	2⅜
	Pinion		Inches.	7.5	7.5	7.5	7.5	11¼	11¼	12	12
	Wheel		Inches.	46⅛	46⅛	51 5/16	51 5/16	66	66	73¼	73¼
Cylinders.	Horse-power			15	15	21	31	37	43.3	62	62
	Stroke		Inches.	10	10	12	12	15	15	15	15
	Diameter		Inches.	6	6	7	8½	9	10	12	12
Single drum			No.	5	6	7	8	9	16½	17½	18
				$825.00	918.50	1,177.00	1,331.00	1,694.00	1,914.00	2,343.00	2,475.00

Indurated Fibre Ware.

SPITTOONS.

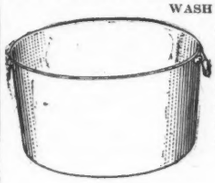
	Doz.
16 in. dia., 8 in. high	$24.00
12½ in. dia., 5¼ in. high	10.80
9 in. dia., 5 in. high	7.80

Dis. on all 25 and 20%.

CORDLEY & HAYES.

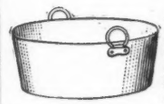
Pails.	No. doz. in crate.	Cubic feet.	Price per doz.
Ladies' or Weaver's pails, 6 qt	1	2¾	$5.35
Half or buggy pails, 6 qt	1	3	4.80
Star pails (standard plain), 12 qt., stenciled "for fire only" without extra charge	1	3½	6.00
Deck or Mason's pails (same size as Star, but heavier, with heavy wire bail)	1	4	6.60
Railroad or fire pails, 14 qt. (also stenciled "fire" without extra charge)	½	3½	7.80
Fire pails, round bottoms	1	4	7.80
Milk pails, 14 qt	1	4	7.80
Stable pails, flush bottom, heavy wire bail, 14 qt	1	4	7.80
Stable pails, 16 qt., same as above	½	3½	8.40
" 18 " "	½	3¾	10.70
" 20 " "	½	4	12.00
Covers for fire or star pails		1	3.35

WASH TUBS.



No. 0, 23 in	½	12	27.00
Nos. 0, 1, 2 and 3, nested	1 n.	3½	22.50
No. 1, 21 in	½	10½	24.00
No. 2, 19¼ in	½	9	21.00
No. 3, 18¼ in	½	9	18.00
Nos. 1, 2, and 3, nested	½	9¾	21.00

KEELERS.



		Doz.
A—20 in.	7 in. deep	16.20
B—19 "	" "	15.00
C—18½ "	" "	14.00
1—17½ "	" "	13.20
2—15½ "	6 in. "	12.00
3—13½ "	5 in. "	10.20
4—12 "	4 in. "	9.00

MILK OR VEGETABLE PANS.

13½ in. dia., 3¼ in. deep, 6 quarts,

$3.60 per doz.

WASH BASINS.

	Doz.
12½ in	$4.80
12⅛ in	4.20
11½ in	3.60

CHAMBER PAILS.

12 in. dia., 9 in. deep, 3 gal. 16.00

WATER COOLERS.

	Doz.
3 gal	$32.00
4 "	40.00
5 "	44.00
6 "	48.00
8 "	64.00
10 "	80.00
12 "	96.00
15 "	120.00

WATER COOLERS AND FILTERS.

	Doz.
4 gal	$96.00
5 "	108.00
6 "	120.00
8 "	144.00
10 "	192.00
15 "	288.00

Lamps.

F. H. Lovell & Co.

Miners'.

Brass, Collar and Breast in one piece, Spout and Body in one piece.

Price, $9 per gross net.

Drummond Electric Hanging Lamp, 300 candle power, complete, each $3.50.

The electric lamp, 60 candle-power.

With decorated shades, nickel, per doz. $22.00

With opal plain shades, nickel, per doz. 18.00.

With decorated shades, brass, per doz. 21.00.

With opal plain shades, brass, per doz. 17.00.

Lamp chimney patent for Sun burners.

Per doz. No. 0, 50 cents. No. 1, 60c. No. 2, 75c.

Hitchcock nickel table lamp (No. 654), each $3.75

" " hanging " 656 " 7.25

" " bracket " 651 " 4.00

" " with reflector 653 " 4.00

French bronze bracket, with reflector, No. 653, each $3.75.

Harp, complete, with square tin shade, per doz., $9.50.

Complete, with Burner and chimney, per doz., $1.50.

Hurricane lanterns 25 cents extra with guards.

875, ¾ wick, without guards, per doz., $5.00.

876, square safety lifting globe, per doz. $5.50.

877, ⅝ wick, safety lifting globe, per doz., $6.75.

Nickel plated diamond reflector reading lamp, 30 candle-power, $13.50 per doz.

Net.

Illuminated night clock, per doz., $27.

PAPER LAMPS.

Lined with oil proof composition.

	No. 0.	No. 1.	No. 2.
Height,	2½ in.	3 in.	3¾ in.
Diameter,	3½ in.	2½ in.	2½ in.
Weight, ⅓ doz.,	3¾ lbs.	1¾ lbs.	2 lbs.
Price, $2.75 per doz.		$2.25	$2.75
	No. 0.	No. 3.	No. 4.
Height,	2½ in.	5 in.	6½ in.
Diameter,	3½ in.	3½ in.	4 in.
Weight, ⅓ doz.,	3¾ lbs.	3½ lbs.	7 lbs.
Price, $2.75 per doz.		$3.25	$4.50

Dis., 20%.

Lawn Mowers.

Forward Cut Mowers.

In.	Lbs.		In.	Lbs.	
10	Weight, 30¾	$13.00	16	Weight, 38	$19.00
12	" 31½	15.00	18	" 41	21.00
14	" 36	17.00	21		34.00

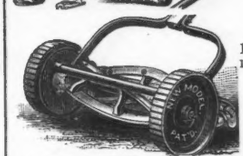
Dis. 60 and 5%.

10 in.	12 in.	14 in.
$13.00	$15.00	$17.00
16 in.	18 in.	20 in.
$19.00	$21.00	$23.00

24 in., $30.00.

Geared at both ends.

Dis. 60 and 5 and 5%.

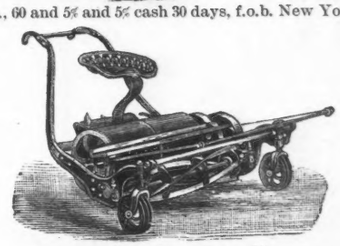


Chadborn & Caldwell Mfg. Co.

10 in. Croquet, 18 pound. mower $11.00

10 in.	13.00
12 in.	15.00
14 in.	17.00
16 in.	19.00
18 in.	21.00
20 in.	23.00

Dis., 60 and 5% and 5% cash 30 days, f.o.b. New York.



New Excelsior Horse Lawn Mower.

25 in. cut, without shafts or seat	$65.00
30 " with shaft and seat	110.00
35 " " " "	135.00
40 " " " "	170.00
Horse boots, per set	12.00

Dis. 50%.

Excelsior Three-Blade Mower and Roller.

8 in.	10 in.	12 in.	14 in.	16 in.	18 in.	20 in.
11.00	13.00	15.00	17.00	19.00	21.00	23.00

Dis. 60% and 5% cash 30 days f.o.b. New York.

Lemon Squeezers.

THE SAMSON

THE ACME.

The Acme Lemon Squeezers, knife and squeezer, per dozen, $15.00.

The Samson, per dozen, $3.00.

Porcelain lined, No. 1, per doz..... $6.00

25 and 30 % discount.

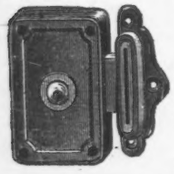
Wood, No. 2, per doz..... $3.00

30 % discount.

Wood, common, per doz..... $1.70

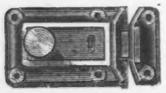
Locks.

YALE PATENT.



RIM STORE LATCH.

	Per doz.
3 × 5 in., 4 keys	$48.00
2½ × 4 in., 3 keys	39.00



RIM NIGHT LATCH.

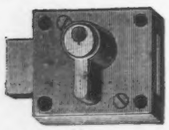
Spring lock, 3 keys	18.00
Dead lock, 3 keys	25.00

NIGHT LATCH.

Escutcheon	39.00
"	36.00

MORTISE DEAD LOCK.

4⅝ × 3½	45.00
2⅜ × 3½	24.00

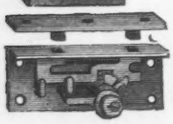


CUPBOARD LOCKS.

Plated Nose	13.20
Brass Nose	12.00

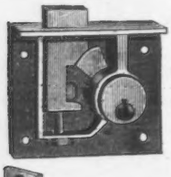
CUPBOARD

Dead Lock	10.80
Spring Lock	13.80



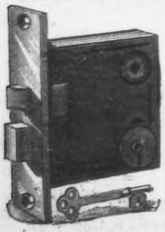
CHEST LOCKS.

Plated nose	19.20
Brass "	18.00



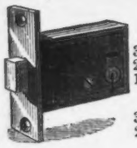
DRAWER LOCK.

Plated nose	10.20
Brass "	9.00



KNOB LOCKS.

5 × 3⅜	22.50
5 × 3⅜	20.00
4¼ × 3⅜	13.25
3½ × 3⅜	10.50



STANDARD LATCHES.

Dead locks.

3¾ × 2¾	21.00
2½ × 3⅜	14.00
1¾ × 2⅜	12.00

NIGHT LATCHES.

3¼ × 3⅜	20.00
2½ × 3¾	18.00

DRAWER LOCKS.

2 × 1⅝, two tumblers.

Plated nose	7.50
Brass "	6.00

Three tumblers.

Plated nose	9.00
Brass "	7.50

RIM FLUSH DRAWER LOCK.

2 in. diameter.

	2 tumblers.	3 tumblers.
Plated nose	7.50	9.00
Brass "	6.00	7.50

BRONZE SPRING PADLOCK.

2 flat steel keys.

In.	
1	11.00
1¼	12.00
1½	13.50
1¾	14.50
2	16.00
2¼	17.50

Subject to special net prices; no discount.

YALE KEYS.

Lumber.—Soft and Hard.

Per 1000 ft.	New York.	Boston.	Per 1000 ft.	New York.	Boston.
Flooring—			Bevel siding—		
4-4 No. 1	$24.00	$26.00	No. 1	15.00	16.00
4-4 " 2	20.00	22.00	No. 2	13.00	14.00
4-4 " 3	17.50	19.50	Base Boards,		
5-4 " 1	26.50	28.50	D. 4 S—		
5-4 " 2	21.00	23.00	4-4 No. 1	26.00	28.00
5-4 " 3	18.50	20.50	4-4 " 1	22.00	24.00
Ceiling—			Stk. Boards, D		
4-4 No. 1	25.00	27.00	2 S—		
4-4 " 2	20.50	22.50	4-4 No. 1	26.50	28.50
5-8 " 1	19.50	20.50	5-4 " 1	28.50	30.50
1-2 " 1	15.75	16.75	6-4 " 1	29.50	31.50
5-8 " 2	15.75	16.75	8-4 " 1	30.50	32.50
1-2 " 2	12.25	13.25	Edge Boards,		
Partition—			D 2 S—		
4-4 No. 1	25.50	27.50	4-4 No. 1	24.50	26.50
4-4 " 2	21.00	23.00	Edge wide, D		
Ger. siding—			2 S—		
4-4 No. 2	25.00	27.00	4-4 No. 1	26.50	28.50
4-4 " 2	21.00	23.00			

5-4, 6-4, and 8-4 edge boards, $1 per M less than stock.
No. 2 stock and edge boards, $3 per M less than No.
Rift flooring, $6 per M more than No. 1 flooring.
Rift flooring, P. & J., $8 per M more than No. 1 flooring.
No. 1 flooring, P. & J., $2 per M. more than P. & M.

⅜ in. black walnut	$52	⅝ in. cherry	55
½ " "	58	¾ "	65
⅝ " "	69	1 to 2 "	90
¾ " "	79	1 to 2 in. butternut	54
1, 1¼ and 1½ in. black walnut	93	1 to 2 in. hickory	45
2 in. black walnut	102	½ in. whitewood	25
2½, 3 and 4 in. black walnut	110	⅝ "	29
⅝ in. basswood	21	¾ "	30
¾ " "	24	1 to 2 "	33
1 to 2 in. "	26	3 and 4 "	37
1 to 3 in. elm	22	1 to 3 in. maple	32
⅝ in. ash	66	1 in. beach	28
1 "	39	1 in. sycamore (plain sawn)	29
1¼ and 1½ in. ash	44	1 in. sycamore (quarter sawn)	45
2 and 2½ "	48	⅝ in. white or red oak (quarter sawn)	29
3 and 4 "	42	1 to 2 in. white or red oak (quarter sawn)	50
1 to 2 in. white or red oak (plain sawn)	45	2½ and 3 in. white or red oak (quarter sawn)	55
½ to 4 in. white or red oak (plain sawn)	40		
½ in. cherry	49		

Machinery—Foot Power.

S., M. & Co.'s Screw-Cutting Engine Lathes.

8 in. swing, 20 in. bet. centers, 36 in. bed, 240 lbs. weight, $60.
8 in. swing, 30 in. bet. centers, 46 in. bed, 260 lbs. weight, $70.
8 in. swing, 36 in. bet. centers, 52 in. bed, 280 lbs. weight, $75.

Boxing for export, $2.50 extra; f.o.b. at Cincinnati, 25 % dis.

SAWS AND LATHES.

Victor Scroll Saw, Cuts to 3 Inches.

24-inch swing, with 12 saw blades.... $40
Dis., 20%.

Empire Scroll Saw, Cuts to 3 Inches.

24-in. swing, drill and tilting table.
Price, boxed..... $25
Dis., 20%

The Acme Combination Saw.

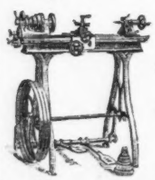
Hand or steam power.
Adjustable table and gauges.

Price, boxed	$40
Scroll saw attachment	7
Boring attachment	10
Moulding attachment	10

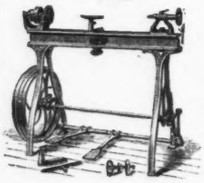
Dis., 20%.

Paragon Self Feed Rip Saw.
Two changes of speed; three changes of feed.
Price, with one 10 in. saw, $50.00.
Dis., 20%.

Diamond Mortising Machine.
With mortise ¼ to 1 in. wide, 3 in. deep.
" cut tenons ⅛ to ¾ thick, 3 in. wide.
Price, with 3 chisels $25.00
Dis., 20%.



The "Star" Lathe.
Swings 9 × 25 in., back geared, screw cutting.
Feeds in or out, right or left. Adjustable Tail Stock for Tapers.
Price..... $75.00
Dis., 15%.



The Crown Lathe.
Swings 10 × 36 in.

Price, boxed	$45.00
Compound slide rest	15.00
Countershaft	10.00

Dis., 20%.

Rival Scroll Saw, with six extra saw blades, twist drill and wrench.
Price..... $10.00
Lathe attachment..... $3.00
Dis., 25%.

The Challenge Scroll Saw, for shell, bone wood, or metal.
Nickel Plated, with six extra saws, twist drill and wrench.
Boxed..... $20.00
With lathe attachment..... $5.00
Dis., 25%.

Hand Circular Rip Saw.
Cuts 3¾ thick, 19 in. wide.
Price $50.00.
Dis., 35%.

Scroll and Circular saw Combined.
Combined Machines.

Combined circular scroll saw and boring attachment—2 circular saws, 12 assorted scroll saws, boring attachment, and self-centering drill chuck	$50.00
Combined circular and scroll saw—2 circular and 12 scroll saws	40.00
Circular saw—1 extra rip and 1 cross-cut saw	35.00
Scroll saw—12 assorted scroll saws	32.00
Counter shaft for steam power	10.00

Dis., 35%.

Foot Power Former.

$20.00; Knives extra, $1.00 each.

Dis., 35%.

Mortising Machine.

$22.00; Chisels, $1.00 each.

Dis., 35%.

Blind Slat Chisels, 3 set bits, $5.00.

Dis., 20%.

Tenoning Machine,

Price, $25.

Dis., 35%.

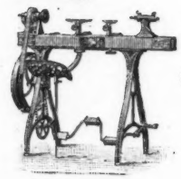
Velocipede Scroll Saw,

Without boring attachment..... $20.00

With " " 23.00

1 doz. saw blades, 1 3-16 bit. } Included.

Dis., 35%.



Lathe.

3 centres, 1 spur, 2 tool rests and sockets, 1 turned face-plate, $35.

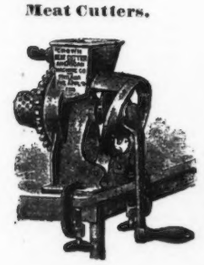
Dis., 30%.

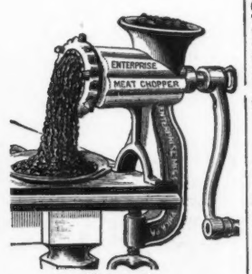
Lathe.

One turned face-plate, two pointed and one spur center, two rests, with sockets and plate for hand tools, slide rest-wrench, belting, etc., $40.

Dis., 25%.

Meat Cutters.





American.

	1	2	3	4
each,	$5.00	7.00	10.00	25.00

Dis., — —.

Enterprise.

	10	12	22	32	42
each,	$3.00	2.50	4.00	6.00	15.00

Dis., 30%.

Mining Machinery.

N. B.—Special attention is invited to the goods advertised and illustrated in the advertising pages of the ENGINEERING AND MINING JOURNAL, quotations and discounts upon which would only mislead buyers.

Price-lists and other information may be obtained by addressing the advertisers direct, or by writing to the ENGINEERING AND MINING JOURNAL.

Mouse Traps.

The Cyclone Mouse Trap, per gross, $4.05.

The Idea Mouse Trap, per gross, $8.25.

Slayer Rat Traps, per gross, $10. Net prices.

Nails and Tacks.

Swedes. Tacks.

Per doz.	½	¾	1	1½	2	2½	3	4
½ wt..	35	40	46	50	55	60	65	75
	6	8	10	12	14	16	18	20	24 oz.
	85	1.00	1.20	1.40	1.60	1.75	1.85	2.15	2.55
Doz. full	½	¾	1	1½	2	2½	3	4
weight	60	70	80	90	1.00	1.10	1.20	1.40
	6	8	10	12	14	16	18	20	24 oz.
	1.60	1.90	2.30	2.70	3.10	3.40	3.80	4.20	5.00
lb., bulk	½	¾	1	1½	2	2½	3	4
or paper	1.60	1.25	1.00	80	66	58	52	46
6	8	10	12	14	16	18	20	24	
36	32	31	30	29	28	28	28	28	

Discount, 67½, 10 and 2%.

O. H. Swedes.

Price, same as Swedes.

Swedes steel tacks same list price as iron.

Upholsterers.

Discounts, 72½, 10 and 2%.

Price, same as Swedes.

Cut Tacks. Price per dozen ounces.

	1	1½	2	2½	3	4	6	8	10
¼ wt.....	..	..	..	..	35	40	45	50	55
	12	14	16	18	20				
	60	70	80	90	1.00				
½ wt.	1	1½	2	2½	3	4	6	8	10
	45	50	50	55	60	65	70	80	95
	12	14	16	18	20				
	1.10	1.25	1.40	1.55	1.70				
Full wt...	1	1½	2	2½	3	4	6	8	
	80	90	90	1.00	1.10	1.20	1.30	1.50	
	10	12	14	16	18	20			
	1.80	2.10	2.40	2.70	3.00	3.30			

Discount, 70, 10 and 2%.

Carpet Tacks, flat and oval heads.

Blued, doz. oz.	4	6	8	10	12	14	16	18	20
¼ wt.	35	40	45	50	55	65	75	85	95
	22	24							
	1.05	1.15							
" ½ wt.	4	6	8	10	12	14	16		
	65	70	80	95	1.10	1.25	1.40		
	18	20	22	24					
	1.55	1.70	1.85	2.00					
Tinned, doz. ¼ wt.	4	6	8	10	12	14	16		
	50	55	60	75	85	1.00	1.10		
	18	20	22	24					
	1.20	1.35	1.45	1.60					
Tinned, doz. ½ wt.	4	6	8	10	12	14			
	95	1.05	1.15	1.40	1.60	1.85			
	16	18	20	22	24				
	2.10	2.35	2.60	2.85	3.10				

Discount, 72½, 10 and 2%.

Finishing Nails.

Inch....	⅜	3½-8	4-8	4½-8	⅝	5½-8	6-8	7-8	1
Per lb...	48	40	32	28	26	24	22	20	18

1½ and larger.

16

Discount, 60, 10 and 2%.

Chair Nails.

Doz. ½ wt. ; doz. full wt.; pound B. or P.

Inch..	⅜	3½-8	4-8	4½-8	⅝	5½-8	6-8	7-8
Per lb.	51	43	35	31	29	27	25	23
	1	1½						
	21	19						

Discount, 60, 10 and 2%.

Common and patent brads.

inch.	Price per doz. ½ wt.	Price per doz. full wt.	Price per lb. in papers or bulk.
2-8.....	.50	1.00	1.25
3-8.....	.60	1.20	.80
4-8.....	.65	1.30	.58
5-8.....	.72	1.44	.48
6-8.....	.80	1.60	.36
7-8.....	.90	1.80	.30
1.....	1.00	2.00	.26
1⅛.....	1.12	2.24	.25
1¼.....	1.26	2.52	.24
1½.....	1.82	3.64	.22
1¾.....	2.25	4.50	.20
2.....	2.43	4.86	.18

Dis. 60, 10 and 2%.

Oars.

Best quality selected White Ash.

	Cents.		Cents.
6 to 12 ft., per sq. ft...	7	22 ft., per sq. ft.....	14
13 " 16 " " " ...	8	24 " " "	18
17 " 18 " " " ...	8½	25 " " "	20
19 " " " ...	10		
20 " " " ...	11		

5 and 2½ cash.

Oils.

LUBRICATING.—Fiske Bros.

Lubroleine A cylinder oil 50 in. barrels.
Lubroleine D cylinder oil 40 in. barrels.
Lubroleine A machine oil 45 in. barrels.
Lubroleine B machine oil 35 in. barrels.
Lubroleine A engine oil 50 in. barrels.
Lubroleine B engine oil 40 in. barrels.
In cases 5c gal. extra.

Crescent Axle Grease.—Barrels, 3c per lb; 100-lb. kegs, 3½c lb.; 2-lb. decorated tins, $12, gross less 5 per cent.

Texas Star Axle Grease.—Barrels, 2½c per lb.; 100-lb. kegs, 3c per lb.

Oil Stones.

Best White Washita.

Green Paper Brand, 8 × 2 × 1⅛ inches.....per lb.		.32
Oil stone, No. 1,	" " ..... "	.22½
" Extra,	" " ..... "	.30
High rounds,	" " ..... "	.30
Round edge slips, Nos. 1, 3½ to 5, in boxes 10 lbs. upwards.....	"	.40
Round edge slips, extra, in boxes 10 lbs. upwards.....	"	.50
Pen knife pieces, ass't 3 to 5 × 1 × 1⅝, in boxes 10 lbs. upwards.....	"	.50
Needle pieces.....per hundred.		$5.00
Wheels, 1½ to 5¾ in. thick.....per inch.		.40

Good Washita,

Oil Stone No. 1, 8x2x1⅛.....per lb.		.15
" " 2, " ..... "		.12
Axe Stone, assorted sizes.....	"	.10
Round Edge Slips, assorted sizes.....	"	.25

Arkansas.

Oil Stone No. 1, 4 to 6 in. long x2x¾ to 1 in. per lb.		$1.35
Oil Stone No. 1, 6 to 9 in. long x2x¾ to 1 in.	"	1.75
Oil Stone No. 2, 4 to 9 in. long x2x¾ to 1 in.	"	.75
Round Edged Slips, assorted sizes	"	2.00
Square File Slips, 3 to 4 inches long.....per doz.		1.75
Diamonds, 3½ to 4 inches long.....	"	3.00
Triangulars, 3½ to 4 inches long.....	"	3.00
Flat Files, 3 to 4 inches long.....	"	2.00
Beveled Files, 3½ to 4 inches long.....	"	2.50
Knife Blades, 3 to 4 inches long.....	"	3.00
Points, extra long, 3 to 3½ inches.....	"	2.00
Points.....	"	1.50
Pen Knife Pieces, assorted sizes.....per lb.		2.00
Needle Pieces.....per hund.		8.00
Wheels, 2 to 4 inches, ½ inch thick.....per inch		1.25
Oil Stone Powder.....per lb.		15

10, 10 and 2½ dis.

Oil Stoves.

Burns 8 hours; holds 1 quart oil.

Nickel plated crown plate, per doz $12.

Paints.

For Assorted Cans of 1, 2, 3 and 5 pounds. 100-lb. cases.

No.	lb.	c.	No.	lb.	c.
533. Scotch yellow	18		583. Black	18	
534. Lead color	18		584. Dark blue	25	
536. Brown	18		585. Chrome yellow	30	
537. Light drab	18		586. Vermilion	30	
539. Buff	18		587. Indian red	25	
542. Warm drab	18		588. Bronze green	25	
544. Dark green	25		589. Quaker green	25	
581. Light green	25		546. Inside white	18	
582. Norway red	18		547. Outside white	18	

Discount 50 per cent.

Ordinary shades. Per gal.		Per gal.
One to 5 gallon cans.. $1.90	Half gallon cans.....	$2.00

Tuscan Red, Green and Yellow.

Per gal.		Per gal.
One to 5 gallon cans.. $3.10	Half gallon cans.....	$3.30

Vermilion.

Per gal.		Per gal.
One to 5 gallon cans.. $5.00	Half gallon cans	$5.20

Discount 40 per cent.

The list in barrels, half-barrels and kegs (of 5 gallons or larger) will be 10c. a gallon less than in gallon cans. Kegs of less than 5 gallons will be charged at gallon price. One-quarter gallon cans not put up. Special shades made to order.

Special cash discount for large orders.

Pipe Covering.

Magnesia Sectional Covering.

For Wrought Iron Pipe. In Canvas Jacketed Sections, 36 inches in length.

Inside dia. of pipe.	Weight of cover per lineal ft.	Price per lineal foot canvas jacketed.
½ in.	8 ozs.	$0.25
¾ "	9 "	0.25
1 "	10 "	0.25
1¼ "	12 "	0.25
1½ "	15 "	0.25
2 "	18 "	0.27
2½ "	20 "	0.31
3 "	24 "	0.36
3½ "	26 "	0.40
4 "	30 "	0.44
4½ "	38 "	0.47
5 "	40 "	0.50
6 "	48 "	0.60
7 "	55 "	0.65
8 "	65 "	0.75
9 "	75 "	0.80
10 "	85 "	0.90

Elb'ws.	Tees.	G Valv's.	Crosses.	Unions.
$0.20	$0.30	$0.25	$0.35	$0.30
0.25	0.33	0.25	0.43	0.33
0.25	0.33	0.25	0.43	0.33
0.25	0.33	0.25	0.43	0.33
0.25	0.33	0.25	0.43	0.33
0.27	0.36	0.27	0.48	0.33
0.31	0.41	0.41	0.53	0.41
0.36	0.48	0.48	0.60	0.48
0.40	0.53	0.53	0.68	0.53
0.44	0.59	0.59	0.75	0.59
0.50	0.65	0.65	0.80	0.63
0.58	0.75	0.75	0.90	0.67
0.65	0.90	0.90	1.00	0.77
0.83	1.20	1.20	1.10	0.90
1.00	1.35	1.35	1.20	1.00
1.10	1.50	1.50	1.35	1.10
1.25	1.75	1.75	1.50	1.25

Magnesia Plastic Covering (dry)—Prepared Carbonate Magnesia and Fiber, for Trowel Work per barrel, $8.00

Dis. 25%.

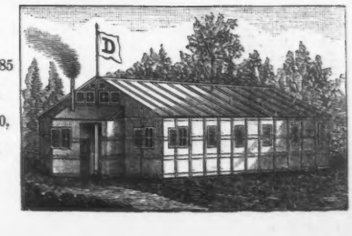
Portable Houses. (Ducker Portable House.)

Weight, 450 lbs.

Price, $150.

Closes securely.

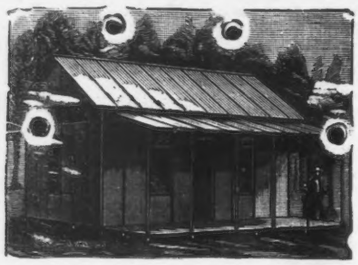
Dis., 10%.



Weight, 85 lbs. per section.

Price, $220.

Dis., 10%.



Weight, complete, 5600 pounds.

No. 10.—26 × 33 ft.. including veranda and rear extension. Main part, 19 × 26 ft. $500.00

	No. 1. Veranda on side.	No. 2. Veranda on end.	No. 3. without veranda.
12 × 12, 1 door, 3 windows,	$120.00	$120.00	$105.00
12 × 14, 1 " 3 "	135.00	130.00	120.00
12 × 17, 1 " 3 "	155.00	150.00	135.00
12 × 19, 2 " 4 "	175.00	165.00	150.00
12 × 21, 3 " 5 "	190.00	180.00	165.00
12 × 23, 3 " 5 "	200.00	190.00	175.00
12 × 26, 3 " 5 "	220.00	205.00	190.00
14 × 21, 3 " 5 "	205.00	195.00	180.00
10 × 12, 1 " 3 "		100.00	90.00
10 × 14, 1 " 3 "		105.00	95.00
7 × 10, 1 " 2 "			65.00
7 × 12, 1 " 2 "			75.00
7 × 14, 1 " 2 "			85.00

Hunter's Cabins.

7 × 12, with 4 berths $80.00
7 × 14, " 4 " 96.00

Discount, 20%.

Post Hole Diggers.

Little Giant	$36.00	doz 11 cu ft.
Hercules	30.00	" " " "
New Champion	20.00	" " " "
Scheidler	36.00	" " " "

Dis. 40% f.o.b. New York or Boston.

Press.

Combined press for cutting, forming, horning and seaming.

Particulars of flat front presses, including beds, slides, bolsters, plates, etc.

Prices are net, delivered on steamers in New York, including insurance, etc.

Nominal size of press	41	42	43	44	45
Price, including et ceteras	$130	$200	$260	$420	$660
Weight, about ..... lbs	600	1050	1900	3600	7200
Greatest diameter that can be wired ..... ins	5	7	10	14	20
Greatest depth that can be wired ..... ins	8	10	13	16½	20
Hole through bed—circle intersecting ..... ins	4½	6	8½	12	17
Hole through back—width ..... ins	8	9½	12	15½	20½
Width between die clamps—clear ..... ins	8	11	15	20	27
Distance back from center of slide bar ..... ins	4½	5½	7	9	12
Height to slide-bar, when up .. ins	5¼	6½	7½	8½	9
Stroke of slide-bar ..... ins	1	1¼	1½	1¾	2
Adjustment of slide-bar ..... ins	1	1¼	1½	1¾	2
Diameter of fly-wheel ..... ins	20	26	32	38	44
Width of fly-wheel ..... ins	3	4	5	6	7
Weight of fly-wheel, about .... lbs	125	250	420	725	1100
Speed per minute, about ..... rev	120	110	100	90	80
Cubic feet boxed, about	30	40	50	60	70

Printers' Sundries.

Vanderburgh, Wells & Co.

Wood rules, 12 cents per yard.
Wood rules, on end wood, 15 cents per foot.

EUREKA STAND.
12 full cases.

Price without cases $12.00
Boxing and cartage 1.25

CASE RACKS.

	In. High.	Plain.	Inclosed sides and back.
Single, to hold 12 cases,	41¼	$6.00	$8.50
" " 16 "	50¾	7.00	9.50
" " 20 "	60¼	8.00	11.00
" " 24 "	69¾	9.00	12.00
" " 30 "	84	10.00	13.50
Double, to hold 32 "	50¾	12.50	16.00
" " 40 "	60¼	14.00	17.50
" " 60 "	84	18.00	23.00

When required we make inclosed case racks trimmed with moldings, and painted or grained. Locking bars, to prevent cases from being removed, furnished to order.

GALLEY RACKS.

8 in., 5 ft. high $3.00
10 " 5 ft. 8½ in. high 3.50
12 " 6 ft. 7 in. high 4.25
15 " 8 ft. high 5.25
20 " 9 ft. 8 in. high 7.00

Arms, per pair, 35 cents.

SHOOTING STICKS.

Each.
No. 1, 75c.
No. 2, $1.
No. 4, 45c., black.
No. 4, 60c., bright.
No. 5, 60c., black.
No. 5, 75c., bright.

GAUGE PINS.
Improved brass gauge pins, 40c. doz., all sizes.
Improved wire gauge pins, 25. doz., all sizes.
Improved steel gauge pins, 60c. doz., all sizes.
Improved golden gauge pins, 40c. doz., all sizes.

MITRE BOXES.
Regular size, 2 in., 50c. each.
Extra size, 3½ in., 75c. each.

LEAD CUTTER.

Curtis' Lead Cutter $2.00

PROOF PRESS, "OUR OWN."

9 × 32, complete, with Brayer $28.00

TYPE CASES.
Full Size.

		Strong slat.
No. 1—Pairs (News)	per pair,	$1.75
3—German	"	1.75
4—Music	"	3.50
4½—Music	"	3.50
5—Greek	"	3.50
6—Hebrew	"	3.50
7—Job (Italic)	each	1.00
7½—New York Job	"	1.00
8—Triple	"	1.00
8½—Paterson Job	"	1.00
9—Yankee Job	"	1.00
10—Lead, No. 1	"	1.00
11—Lead, No. 2	"	1.00
12—Lead, No. 3	"	1.00
13—Quad, No. 1	"	1.00
13½—Quad, No. 2	"	1.25
14—Labor Saving Rule, No. 1	"	1.20
15—Labor Saving Rule, No. 2	"	1.20
16—Labor Saving Rule, No. 3	"	1.20
17—Slug	"	1.00
18—Border	"	1.00
19—Blank or Cut	"	
19½—Improved Wood Type	"	
20—Sort, No. 1, extra deep	"	1.50
41—Sort, No. 2, extra deep	"	1.50

PROOF GALLEYS.

All Wood.

Single column, 4⅛ × 25 inches inside $0.80
Double " 7 × 25 " " 90

Brass Bottom.

Single column, 3⅝ × 23¼ inches inside $1.25
Double " 6¾ × 23¼ " " 1.50

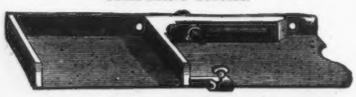
Half Lined.

Single column, 3⅝ × 23¼ inches inside $1.76
Double " 6¼ × 23¼ " " 2.25

All Brass.

Single column, 3¾ × 23¾ $2.50
Double " 6¼ × 23½ 3.00

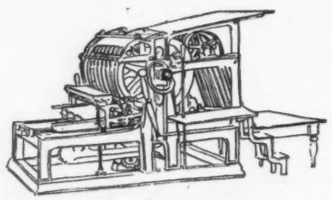
COMPOSING STICKS.



GROVER'S PATENT AND UNION.

	Screw or News.
6 in., 1.10	$ .75
8 " 1.20	.80
10 " 1.40	1.00
12 " 1.60	1.15
14 " 1.80	1.30
16 " 2.00	1.45
18 " 2.20	1.60
20 " 2.40	1.75

Composing rules, 14 ems pica and under, 25 cents.



THE "LIBERTY" CYLINDER PRESS.

For Newspaper and Job Printing.

Bed.	Form.	
No. 5—29 × 42	24 × 40	$1,200
6—33 × 47	28½ × 45	1,300
7—37 × 51	33 × 49	1,600

Dis., 20 and 5%.

THE "LIBERTY" JOB PRINTING PRESS.
Size of chase.

No. 2 — 7	× 11	$200
2a— 9	× 13	250
3 —10	× 15	300
3a—11	× 17	350
4 —13	× 19	400
5 —14½	× 22	500

Dis., 12½ and 5%.

Two sizes built extra strong for boxmakers, embossing, etc.

No. 3a—11	× 17	$375
4 —13	× 19	425

Dis., 12 and 5%.

Franklins, either size, $25 extra, if ordered with press.
Steam fixtures, either size, $15 extra.

THE AMERICAN CARD AND BILL HEAD PRESS.

No. 5—4 × 6 ..... $16
7—6 × 9 36
8—8 × 12 60

Dis., 20% and 5%.

THE "LIBERTY" PAPER CUTTER.

Cuts 30 inches $140.00
Extra knife 18.80

Dis., 12½ and 5%.

THE "LIBERTY" IMPOSING TABLES.

Marble top.

No. 1—24 × 36 ..... $24
2—32 × 48 38
3—26 × 74 44
4—36 × 48 48

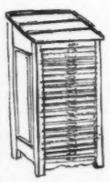
Dis., 12½ and 5%.

Slate Top.

No. 1—24 × 36 ..... $18
2—32 × 48 25
3—26 × 74 32

Dis., 12½ and 5%.

THE "LIBERTY" TYPE CABINETS.



Number of cases.	Stained. Flat. $	Stained. Galley.* $	Grained. Flat. $	Grained. Galley.* $
12⅞	12.00	14.50	14.00	17.00
16⅞	15.00	17.50	17.00	20.00
18⅞	16.50	19.00	18.50	21.50
20⅞	18.00	20.50	20.00	23.00
12¾	15.00	17.50	17.00	20.00
16¾	18.00	20.50	20.00	23.00
18¾	19.50	22.00	21.50	24.50
20¾	22.00	24.50	23.00	26.00
12 full	18.00	20.50	20.00	23.00
16 "	22.00	24.50	24.00	27.00
18 "	24.00	26.50	26.00	29.00
20 "	26.00	28.50	28.00	31.00

Number of cases.	Pine. Flat. $	Pine. Galley.* $	Cherry. Flat. $	Cherry. Galley.* $	Napanoch. Flat. $	Napanoch. Galley.* $	Walnut. Flat. $	Walnut. Galley.* $
12⅞	18.00	21.00	20.00	23.00	22.00	25.00	23.00	26.00
16⅞	22.00	25.00	24.00	27.00	26.00	29.00	27.00	30.00
18⅞	24.00	27.00	.....	.....	.....	.....	.....	.....
20⅞	26.00	29.00	28.00	31.00	30.00	33.00	31.00	34.00
12¾	21.00	24.00	23.00	26.00	25.00	28.00	26.00	29.00
16¾	25.00	28.00	27.00	30.00	29.00	32.00	30.00	33.00
18¾	27.00	30.00	.....	.....	.....	.....	.....	.....
20¾	29.00	32.00	31.00	34.00	33.00	36.00	34.00	37.00
12 full	24.00	27.00	26.00	29.00	28.00	31.00	29.00	32.00
16 "	28.00	31.00	30.00	33.00	32.00	35.00	33.00	36.00
18 "	30.00	33.00	.....	.....	.....	.....	.....	.....
20 "	32.00	35.00	34.00	37.00	36.00	39.00	37.00	40.00

*Furnished with galley top and extra drawer for copy.
Dis., 20 and 5%.

THE "LIBERTY" CASE STANDS AND RACKS.

Stands.

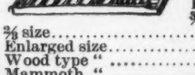
Single, without racks $3.75
" with racks for 8 full cases 4.00
Single, with racks for 10 full cases 4.25
Single, with racks for 12 full cases 4.50
Single, with racks for 14 full cases 4.75
Double, without racks 4.25
" with racks for 8 full cases 4.50
Double, with racks for 16 full cases, and gal. rest 6.25
Double, with racks for 20 full cases and gal. rest 6.50
" " " " 24 " " " " " " 6.75
" " " " 24 ⅔ cases 5.25
" " " " 8 full and 8 ⅔ cases 5.00
" " " " 8 " " 8 ⅔ " 5.25
" " " " 10 " " 12 ⅔ " 5.50
" " " " 12 " " 16 ⅔ " 5.75
" " " " 12 " " 16 ¾ " 6.00
Stands with closed ends, extra 2.00
Extra slides for stands, each ..... .05

Case Racks.

Cases.	Inches High.	Inclosed Back and Sides. Price.	Cases.	Inches High.	Inclosed Back and Sides. Price.
12	41	$6.00	$8.50	30	84	$10.00	$13.50
16	50	7.00	9.50	32		12.50	16.00
20	60	8.00	11.00	40	60	14.00	17.50
24	70	9.00	12.00	60	84	18.00	23.00

Dis., 20 and 5%.

THE "LIBERTY" TYPE CASES.



	Name.	Outside Measurements.
Full size		32¼x16½x19-16
Rooker size		28½x14¼x1 9-16
¾ size		26x16½x1¾
⅔ size		22⅜x16½x1⅝
Enlarged size		32¼x23x2 3-16
Wood type "		32¼x23x1 9-16
Mammoth "		44x23x1 9-16

Cabinet case sides extend 1½ to 3 inches. In ordering cabinet cases, state whether high or low fonts are wanted.

	Without Pat. Clasps.	With Pat. Clasps.
News, full, per pair	$1.60	$1.75
" Rooker, "	1.60	1.75
" ¾ "	1.50	1.60
" ⅞ "	1.40	1.50
German, full, "	1 60	1.75
Music " "	2 00	2.20
Job " "	.90	1.00
Job, full size, California	.90	1.00
" Rooker	.90	1.00
" full, Yankee	.90	1.00
" ¾ Regular	.80	.90
" ⅞ Yankee	.75	.85
" " Boston	.75	.85
" " California	.75	.85
" " improved	.90	1.00
" full size, Middletown	1.20	....
" " Paterson	.90	....
" " New York	.90	1.00
Quadruple, full size	1.20	....
Double lower, "	1.20	....

Name.	Without pat. clasps.	With pat. clasps.
Galley lower, full size	$1.10	
Enlarged Yankee job	2.20	
Enlarged German	2.20	
Founder's sort case	2.20	
Half-cap	.50	
L. S. lead, full-size	1.00	
" rule "	1.15	$1.25
" " ¾ size	.95	1.05
" " ⅞ "	.80	.90
Improved, ⅞ "	.90	1.00
Space and quad, full-size	1.00	
Slug "	1.00	
Figure "	.90	
Triple "	.90	1.00
Improved triple "	.90	1.00
Triple, ¾ size	.80	.90
Blank, full-size	.65	
" ¾ size	.55	
" ⅞ size	.50	
Script, full-size	.90	
" ¾ size	.80	
" ⅞ size	.75	
Wood type, 23x32¼	1.10	
Mammoth, 23x44	1.30	
Metal furniture, full-size	1.25	
Border "	1.25	
" ¾ size	1.00	
Leader, ⅞ size, per pair	1.40	
Butler jobs, full-size, per pair	3.00	
For pulls on cabinet cases add per case		.10
For rollers " "		.30

Dis., 25 and 5%.

THE " LIBERTY" GALLEYS.
All brass " indestructible."

Single, 3¾ x 23¾ inside	$2.50
" 3¾ x 17¾ "	2.00
" 3¾ x 11¾ "	1.75
Medium, 5 x 23¾ inside	2.75
Double, 6¼ x 23¾ inside	3.00

Dis., 33⅓%.

SMOOTH LINED NEWS GALLEYS.

Half-lined.	Full-lined.	Half-lined.	Full-lined.
Single col. $1.75	$2.00	Double col. $2.00.	$2.50

Dis., 20% and 5%.

SCREW GALLEYS.

	Unlined.	Half-lined.	Full-lined.
Single column	$1.25	$1.50	$1.75
Double column	1.50	1.75	2.00

Dis., 20% and 5%.

SMOOTH LINED JOB GALLEYS.

Size.	Unlined.	Full-lined.	Size.	Unlined.	Full-lined.
6 × 10	$1.25	$2.00	12 × 18	$2.50	$3.50
8¼ × 13	1.50	2.50	14 × 20	3.00	4.00
9 × 14	1.75	2.75	15 × 22	3.50	5.00
10 × 16	2.00	3.00	18 × 25	4.00	5.50

Dis., 20% and 5%.

RULED GALLEYS.

These have a rule laid out on one of the rims, divided into quarter inches, by which to set advertisements. Cost of ruling extra, 25 cents.

Dis., 20% and 5%.

MAILING GALLEYS.

Zinc bottom, 50 cents; brass bottom, 90 cents. Brass, closed both ends, $3.

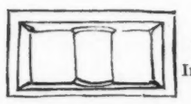
Dis., 20% and 5%.

GALLEY RACKS.

From $3 up.

LEAD CUTTERS,
From $2 up.
Dis., 20% and 5%.

THE " LIBERTY "
STEEL SHOOTING STICKS.
From $2 up.
Nickelplated, $1.25 each.
Dis., 40%.



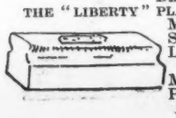
STANDARD METAL FURNITURE
25c. a pound.
In fonts of 25, 50, 75 and 100 lbs.
Dis., 15%.

THE " LIBERTY " MALLETS.

Hickory, small	$ .20
" medium	.25
" large	.30
" iron bound	1.00
Lignum Vitæ, No. 4	.30
" No. 3	.40
" " No. 2	.50
" " No. 1	.70

Dis., 20 and 5%.

THE " LIBERTY " PLANERS AND PROOF PLANERS.



Midget planer	10c.
Small Maple	20c.
Large "	25c.
" b'ked with leather	30c.
Midget " " "	12c.
Proof planer, faced with cloth,	50c.

Dis., 40%.

THE " LIBERTY " COMPOSING STICKS.

Grover.

6 in., Steel	$ .90	16 in., Steel	$1.80
8 "	1.00	18 "	2.00
10 "	1.20	20 "	2.20
12 "	1.40	Extra Clasp	.10
14 "	1.60	Extra Knee	.40

Screw.

6 in., Steel	$ .75	16 in., Steel	$1.45
8 "	.80	18 "	1.60
10 "	1.00	20 "	1.75
12 "	1.15	Extra Knee	.30
14 "	1.30	" Screw and Nut	.10

Dis., 40%.

Yankee.

6-in., Steel	$ .75	12 in., Steel	$1.15
8 "	.80	Extra Knee	.30
10 "	1.00	" Clamp and Screw	.15

Other Sizes to Order.

Dis., 40%.

Albion.

6-in., Steel	$1.00	6-in., German Silver	$1.50
8 "	1.10	8 " "	1.75
Extra Knee	.40	Extra Screw and Nut	.10

Pumps.

Rumsey & Co.
Prices on all pumps include cylinders.

No.	Dia. Cyl.	Suction.	Cap. stroke.	Price Iron.	Price Brass cyl.
0	2 in.	1 in.	1-15 gal.	$3.50	.....
1	2¼ "	1 "	1-12 "	4.00	$6.00
2	2⅜ "	1¼ "	1-11 "	4.50	7.00
3	2½ "	1¼ "	1-10 "	5.00	8.00
4	3 "	1¼ "	1-6 "	5.50	10.00
5	3¼ "	2 "	1-5 "	6.50	14.00
6	3½ "	2 "	1-4 "	8.00	18.00
7	4 "	2½ "	1-3 "	12.00	20.00

Dis., 65%.

1	2½ in.	1¼ in.	1-10 gal.	4.25	.....
2	3 "	1¼ "	1-7 "	4.75	.....
3	3½ "	1¼ "	1-5 "	5.25	.....
4	4 "	1½ "	1-4 "	5.75	.....
5	4½ "	1½ "	1-3 "	6.25	.....

Dis., 70%.

Standard and Cylinder for 1½ in. Iron Pipe, $16.00.

Dis., 55%.

No. 6½, standard and cylinder, 1¼ in. pipe, $13.00.
No. 7½, standard and cylinder, 1¼ in. pipe, $15.00.
No. 8½, standard and cylinder, 1½ in. pipe, $18.00.
With hose and discharge pipe, add $3.00 to list price.

Dis. 55%.

No. 1, diam. cyl, 2½ in.; cap. stroke. 1-8 gal.; size pipe, 1¼ in. Price, iron, $12.50; brass cyl., $17.50.
No. 2, diam. cyl., 3 in.; cap. stroke, 1-6 gal.; size pipe, 1¼ or 1½ in. Price, iron, $14.50; brass cyl., $18.50.
No. 3, diam. cyl., 4 in.; cap. stroke, 2-5 gal.; size pipe, 1½ or 2 in. Price, iron, $23.50; brass cyl., $34.50.

Dis., 55%.

No. 1, diam. cyl., 3 in.; suction, 1¼ in.; cap. stroke, 3-10 gal. Price, iron, $28.00; brass cyl., $58.00.
No. 2, diam. cyl., 4 in.; suction, 1½ in.; cap. stroke, 1-2 gal. Price, iron, $32.00; brass cyl., $60.00.
No. 3, diam. cyl., 5 in.; suction, 2 in.; cap. stroke, 6-7 gal. Price, iron, $35.00; brass cyl., $90.00.
No. 4, diam. cyl., 6 in.; suction, 2½ in.; cap. stroke, 1 1-5 gal. Price, iron, $45.00; brass cyl., $120.00.

Dis., 45%.

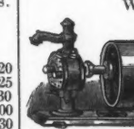
No.	Diam. cyl.	Cap. stroke.	Stroke.	Pipe.	Price.
0	2 in.	1-11 gal.	7 in.	1 in.	$21.50
00	2½ "	1-7 "	7 "	1¼ "	23.00
1	3 "	1-5 "	7 "	1½ "	25.25
2	3½ "	1-3 "	7 "	1½ "	27.25
3	4 "	4-10 "	7 "	2 "	30.50
3½	4½ "	1-2 "	7 "	2 "	37.50
4	5 "	8-10 "	10 "	2½ "	44.00
4½	5¼ "	1 "	10 "	2½ "	47.00
5	6 "	1 1-5 "	10 "	3 "	50.00

Dis., 40%.

No.	Diam. cyl.	Cap. stroke.	Diam. pipe.	Price. Br's Iron.	Br's cyl.
1	2 in.	1-5 gal.	1 in.	$39	$51
2	2½ "	1-3 "	1¼ "	41	56
3	3 "	1-2 "	1½ "	45	62
4	3½ "	6-7 "	2 "	51	81
5	4 "	7-8 "	2 "	63	114
6	4½ "	1 "	2 "	80	155

Dis., 40%.

With Tight and Loose Pulleys.



No. 1, cap. per rev., 1-6 gal.; size of pipe, 1¼ in.; price, iron, $26; bronze, $45.
No. 2, cap. per rev., 1-5 gal.; size of pipe, 1½ in.; price, iron, $31; bronze, $55.
No. 4, cap. per rev., 1-3 gal.; size of pipe, 2 in.; price, iron, $48; bronze, $75.
Pulleys on Nos. 1 and 2 are 8 in. diam., 2½ in. face; on No. 4, 12 in. diam., 3½ in face.
Balance wheels for above pumps. $1, $2, and $3, according to size.

Dis., 45%.

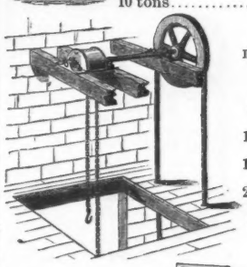
No. 2, ½ to 2 gal. per min.; length of drive pipe, 25 to 40 ft.; calibre of pipes, drive, ¾ in.; discharge, ⅜ in.; price, $9.
No. 3, 1 to 4 gal. per min.; length of drive pipe, 25 to 40 ft.; calibre of pipes, drive, 1 in.; discharge, ⅝ in.; price, $11.
No. 4, 2 to 8 gal. per min.; length of drive pipe, 25 to 40 ft.; calibre of pipes, drive, 1½ in.; discharge, ½ in.; price, $14.
No. 5, 3 to 14 gal, per min.; length of drive pipe, 25 to 40 ft.; calabre of pipes, drive, 2 in.; discharge, 1 in.; price, $22.
No. 6, 4 to 25 gal. per min.; length of drive pipe, 30 to 40 ft.; calibre of pipes, drive, 2½ in.; discharge, 1¼ in.; price, $40.
No. 7, 8 to 60 gals. per min.; length of drive pipe, 30 to 40 ft.; calibre of pipes, drive, 4 in.; discharge, 2 in.; price, $75.
No. 8, 12 to 120 gal. per min.; length of drive pipe, 30 to 50 ft.; calibre of pipes, drive, 6 in.; discharge, 2½ in.; price, $125.

Dis., 45%.

Pulley Blocks.

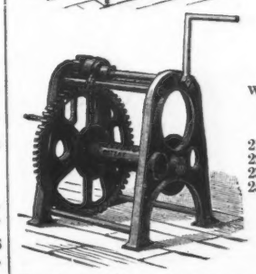
WESTON DIRECT.

	Each.
⅛ ton	$10
¼ ton	13
½ ton	15
1 ton	20
1½ tons	25
2 tons	30
3 tons	40
Geared.	
1 ton	35
2 tons	45
3 tons	60
4 tons	80
5 tons	110
6 tons	150
8 tons	210
10 tons	275



DOUBLE LIFT HOISTS FOR HATCHWAYS, ETC.

500 lbs	$25.00
1000 "	50.00
1500 "	65.00
2000 "	80.00
500 "	30.00



WESTON CRAB SAFETY BRAKE, HANDLES CANNOT FLY BACK.

Each.	
21	$35.00
22	45.00
23	65.00
25	100.00

Railroad Dumping Cars and Carts.

A. C. McEWEN.

Cars.	Gauge.	Capacity.	Price.	Capacity.	Price.	Capacity.	Price.
Side Dumping	24"	1 c. y.	$55	2 c. y.	$65	3 c. y.	$75*
End "	"	"	55	"	65	"	75*
Revolving "	"	"	70	"	80	"	90*
Bottom "	"	"	80	"	90	"	100*
Tunnel	"	"	55	"	65	"	75*
Mine	"	"	50	"	60	"	70*
Plantation	30"		43				
Logging	36"		170				
"	4' 8½"		185				
Hand	36"		45				
"	4' 8½"		50				
Push	36"		40				
"	4' 8½"		45				
R.R. Construction	36"		60				
"	4' 8½"		65				
Carts.							
Plantation and Railroad Wagons.			45 to 75				
McEwen Patent Dumping		1 "	175	1½ "	200		

*These cars built of any gauge from 18" to 56½" and of any capacity from ⅛ to 6 cu. yd.

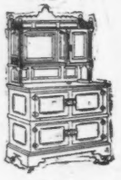
Refrigerators.
Indurated Fibre and Stoneware, Lined.
Cordley & Hayes.

No. 35.

Nos. 75, 85.

No.	High.	Wide.	Deep.	Price.
35	46¼	28¾	20¼	$20.00
75	44¼	33¼	23½	28.00
85	47¾	38	23½	34.00

No. 2.



No. 6.

No.	High.	Wide.	Deep.	Price.
2	41	46	26	$36.00
6	84	46	26	60.00

Mirror 16 by 18 in.
Dis., 30 and 5%.

Rules.
"Lufkin." Steel Rules, per doz.

	Rules only.	In leather cases.
No. 31, 1 ft. folding pocket	$4.00	$5.50
" 31, 2 " " "	8.00	10.00
" 41, 1 " " "	4.00	5.50
" 41, 2 " " "	7.50	9.50
" 41, 3 " " "	11.00	13.50
" 41, 4 " " "	14.50	17.00

	1 ft.	2 ft.	3 ft.
No. 60, ¾ × 21 gauge	$4.00	$8.00	.....
No. 62, 1¼ × 16 "	8.00	15.00	$22.00

Discount, 60 and 10%.

Tinner's Rules.

No. 95, 3 ft. circumference rules	each $2.50
No 95, 4 ft. " "	" 3.00

Discount, in dozen lots, 50%.

	₰ doz.
No. 51, 3½ ft. steel board rules	$42.00
No. 52, 3 " " "	36.00
No. 52½, 2½ ft. " " "	33.00

Discount, 50%.

Sad Irons. (Mrs. Potts' Patent).

With detachable wood handles, in sets of 3 irons, 1 handler, 1 stand (1 each Nos. 1, 2 and 3 iron weighing 4, 5 and 6 pounds respectively.)

	D'ble Pointed. Nickel Plated	D'ble Pointed. Plain P'l'sh'd	Square Back. Nickel Plated	Square Back. Plain P'l'sh'd
No.	150	155	160	165
Price per doz. sets	$30.00	$24.00	$30.00	$24.00
Irons not in sets, either in Nos. 1, 2 or 3, with handles, per doz	12.50	10.50	12.50	10.50
Without handles, per doz	8.50	6.50	.50	6.50
No. 4 iron, extra heavy, weight 7 lbs., with handles, per doz	.....	.....	15.00	15.00
Without handles, per doz	.....	.....	11.00	8.00

Polishing irons with handles.
(Double point.)

	Large size, weight 4½ lbs. each. Nickel Plated	Large size, weight 4½ lbs. each. Plain P'l'sh'd	Small size, weight 3 lbs. each. Nickel Plated	Small size, weight 3 lbs. each. Plaid P'l'sh'd
No.	180	185	182	187
Price per doz	$15.00	$3.00	$11.00	$9.00

Girls' irons with handles.
Same as No. 1 iron in set, but smaller size. Weight, 2 lbs each.

(Double point.)

Nickel plated. No. 190, per doz	$7.50
Plain polished, No. 195, per doz	6.00
Extra handles for any size, per doz	4.00
Extra stands for any size, per doz	.60

Star Irons,
With Perforated Iron Handle. Not detachable. Assorted either No. 1, 2 or 3 sizes, correspond to the detachable handle irons in sets.

	D'ble pointed. Nickel Plated	D'ble pointed. Plain Plish'd	Square back. Nickel Plated	Square back. Plain Plsh'd
No.	70	75	71	76
Price per doz	$7.25	$5.50	$7.25	$5.50

Polishing Irons.
Small Size. 3 lbs each. Doubled Pointed.

Nickel Plated.	Plain Polished.
No. 72, per doz. $7.25	No. 77, per doz. $5.50

Girls' Irons.
Double-pointed, 2 lbs. each; similar to detatchable handle irons.

Nickel-plated, No. 100	$5 per doz
Plain polished, No. 105	$3.75 "

Toy Irons.
Weight, 14 ounces each, nickel-plated (No. 110), $3.25 per dozen; plain polished (No. 115), $2.50 per dozen.
Weight, 5 ounces each, nickel-plated (No. 120), $2 per dozen; plain polished (No. 125), $1.05.
Discount on all Sad Irons 50 and 5%.

Sash Chains.

No. A. "Giant" metal, 15c. pr. ft., wts. not over 125 lbs.
No. 1. "Giant" metal, 12c. pr. ft., wts. not over 75 lbs.
No. 2. "Giant" metal, 10c. pr. ft., wts. not over 40 lbs.
No. 0. "Giant" metal, 8c. pr. ft., wts. not over 25 lbs.
No. 1. Red metal, 10c. pr. ft., wts. not over 40 lbs.
No. 2. Red metal, 8c. pr. ft., wts. not over 30 lbs.
No. 0. Red metal, 6c. pr. ft., wts. not over 15 lbs.
No. 1. Steel, 8c. pr. ft., wts. not 75 lbs.
No. 2. Steel, 6c. pr. ft., wts. not over 30 lbs.
No. 0. Steel, 4c. pr. ft., wts. not over 15 lbs.
No. 1. Steel, black enameled, 9c. pr. ft., wts. not over 75 lbs.
No. 2. Steel, black enameled, 7c. pr. ft., wts. not over 30 lbs.
No. 0. Steel, black enameled, 5c. pr. ft., wts. not over 15 lbs.

Fastenings for hanging a window of 2 sashes for Nos. 1 and 2 chains, consisting of 4 hooks, 4 rings, 4 sash irons, a set, 18c. per set.

Fastenings for hanging a window of 2 sashes for No. 0 chains, 14c. per set.

Dis. on "Giant" metal chain 40 10 10%
" " Red metal chain 40 10 10 10%
" " Steel " " 40 10 10 10%
" " Fastenings 40 10 10%

Scales.—Discount on all scales 50 per cent.

Postal scales.

No 1, capacity ½ to 9 oz., $3.00.
No. 2, capacity ½ to 12 oz., $4.00.
No. 3, capacity ½ to 34 oz., $6.00
No. 4, capacity ½ oz. to 4 lbs., $8.00

Even balance trip scales seamless scoop, with weights.

No. 1, capacity ½ oz. to 2 lbs., tin scoop, $5.50; brass scoop, $6.50.
No. 2, capacity ½ oz. to 4 lbs., tin scoop, $6.50; brass scoop, $7.50.
No. 2½, capacity ½ oz. to 18 lbs., tin scoop, $11; brass scoop, $12.50.

Butter Trip Scales, slab, weights and scoop.

No. 7, ½ oz. to 10 lbs., 10 in. slab,	without side beam		$10.50
" " " " " "	"	with "	11.50
" 8 " " 20 lbs., 12 in. "		without "	12.50
" " " " " "	"	" "	13.50

Tea Scales—All Seamless Scoops.

Capacity.	Scoop.	Capacity.	Scoop.
¼ oz. to 10 lbs.	Tin ..$8.00	¼ oz. to 10 lbs.	Brass ..$9.00

Druggists.

Capacity.	Scoop.	Capacity.	Scoop.
1-16 oz. to 8 lbs.	Tin ..$10.00	1-16 oz. to 8 lbs.	Brass..$11.00

Counter.

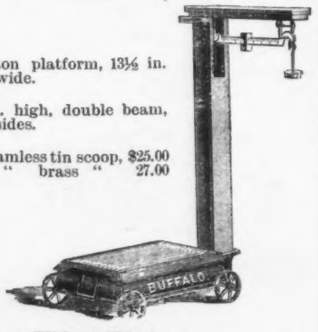
Capacity.	Scoop.	Capacity.	Scoop.
½ oz. to 36 lbs.	Tin ..$10.00	½ oz. to 36 lbs.	Brass..$12.00

Grocer.

Capacity.	Scoop.	Capacity.	Scoop.
½ oz. to 62 lbs.	Tin ..$12.00	½ oz. to 62 lbs.	Brass..$14.00

Meat or Butter Scales, with Slab.

½ oz. to 62 lbs., with Single Beam	$14.00
" " " " Double "	15.00



Patent Boston platform, 13½ in. long by 10 in. wide.

Pillar, 18 in. high, double beam, marked both sides.

With large seamless tin scoop, $25.00
" " " brass " 27.00

Platform scales.—Without Wheels.

No.	Capacity.	Platform.	Price.
1	400 lbs.	21½ by 15 inches.	$23.00
2	600 lbs.	25 by 16 "	30.00
3	800 lbs.	25 by 17 "	34.00
4	1,000 lbs.	26 by 17 "	39.00
5	1,200 lbs.	28 by 20 "	45.00
6	1,600 lbs.	29 by 21 "	55.00
7	2,000 lbs.	32 by 23 "	70.00

With Wheels.

No.	Capacity.	Platform.	Price.
1	400 lbs.	21½ by 15 inches.	$26.00
2	600 lbs.	25 by 16 "	33.00
3	800 lbs.	25 by 17 "	38.00
4	1,000 lbs.	26 by 17 "	43.00
5	1,200 lbs.	28 by 20 "	49.00
6	1,600 lbs.	29 by 21 "	60.00
7	2,000 lbs.	32 by 23 "	75.00

Brass sliding poise at same price if so specified in order.

With Wheels and Drop Lever.

No.	Capacity.	Platform.	Price.
4	1,000 lbs.	26 by 17 inches.	$51.00
5	1,200 lbs.	28 by 20 "	59.00
6	1,600 lbs.	29 by 21 "	70.00
7	2,000 lbs.	32 by 23 "	82.00
8	2,500 lbs.	33¼ by 24¾ "	94.00
9	3 000 lbs.	38 by 30 "	125.00

School Slates.

Noiseless School Slates.
Winsboro Cord Bound.

Size.	Doz. in case.	Price per case.
5 by 7	18	$18.00
6 by 9	12	15.00
7 by 11	10	14.40
8 by 12	8	14.00
9 by 13	6	12.00

Dis., 50 and 2½%.

"D" School Slates.
Winsboro Oval Round Corner.

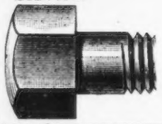
	Doz. in case.	Price per case.
4 by 6	24	$10.80
5 by 7	18	9.00
6 by 8	12	8.20
6 by 9	12	8.64
6½ by 10	12	9.00
7 by 10	10	7.70
7 by 11	10	8.00
8 by 12	8	8.00
9 by 13	6	7.20

Dis., 200 case lots, 50 and 2½%.

Stamp Head Shoes and Dies.

Shoe & Die (Adamantine), showing even wear from end to end.
Chrome Steel Works.
8 cents per lb f.o.b. New York.

Screws.



STEEL SCREWS ADD 50% TO LIST.
Prices are per 100.
Hexagon Cap Screws.
Heads on Steam-tight Screws not polished, unless so ordered. Can make these 12 inches long.

Lgth under head. Diam.	Diam. head.	Length head.	7-16	½	9-16	⅝	¾	13-16	⅞	1	1⅛	1¼	1⅜
			¼	5-16	⅜	7-16	½	9-16	⅝	¾	⅞	1	1¼
¾	Diam. screw.		¼	5-16	⅜	7-16	½	9-16	⅝	¾	⅞	1	1¼
1			3.00	3.25	3.75	4.40	5.50	7.00					
1¼			3.25	3.50	4.00	4.70	5.70	7.00	9.50				
1½			3.50	3.75	4.25	5.00	6.00	7.50	9.50	12.20			
1¾			3.75	4.00	4.50	5.30	6.30	8.00	10.00	12.20	16.00		
2			4.00	4.25	4.75	5.60	6.60	8.50	10.60	12.80	16.60	21.20	
2¼			4.25	4.60	5.05	5.95	7.00	9.10	11.20	13.40	17.20	22.30	29.00
2½				5.00	5.40	6.35	7.50	9.70	11.90	14.10	17.90	23.60	30.50
2¾					5.80	6.80	8.00	10.40	12.70	14.90	18.80	25.10	32.30
3						7.30	8.60	11.20	13.60	15.90	20.00	26.90	34.40
							9.30	12.10	14.70	17.00	21.80	29.00	37.00
	Thread to in.		20	18	16	14	12	12	11	10	9	8	7
	Add for each ¼ in.		30	40	50	60	80	1.00	1.30	1.60	2.00	2.40	3.00

Dis., heads ground, 60%; dis., heads black, 60 and 5%; dis., heads extra finish, 50%; dis., heads case-hardened, 55%; dis., heads polished after hardening, 45%.

SQUARE CAP SCREWS.

Lgth under head. Diam.	Diam. head.	Length head.	⅜	7-16	½	9-16	⅝	11/16	¾	⅞	1⅛	1¼	1⅜
			¼	5-16	⅜	7-16	½	9-16	⅝	¾	⅞	1	1⅛
¾	Diam screw.		¼	5-16	⅜	7-16	½	9-16	⅝	¾	⅞	1	1⅛
1			2.40	2.75	3.20	3.80	4.40	5.75					
1¼			2.60	2.95	3.40	4.00	4.70	5.75	7.70				
1½			2.75	3.10	3.65	4.20	4.95	6.05	7.70	10.50			
1¾			2.90	3.30	3.85	4.45	5.25	6.35	8.25	10.50	14.00		
2			3.05	3.50	4.10	4.70	5.55	6.65	8.80	11.10	14.80	18.00	
2¼			3.25	3.70	4.35	4.95	5.90	7.05	9.40	11.80	15.70	19.00	22.50
2½				4.00	4.65	5.25	6.30	7.55	10.10	12.60	16.70	20.20	24.00
2¾					5.00	5.60	6.75	8.15	10.90	13.50	17.80	21.50	25.80
3						6.00	7.25	8.85	11.80	14.60	19.10	23.10	27.90
							7.80	9.65	12.80	15.90	20.60	25.00	30.50
	Thread to in.		20	18	16	14	12	12	11	10	9	8	7
	Add for each ¼ in.		25	35	45	55	65	90	1 20	1.50	1.80	2.30	3.00

Dis., heads ground, 65%; dis., heads black, 65 and 5%; is., heads extra finish, 55%; dis., heads case harden ed, ∧ %; dis., heads polished-hardened, 50%.

MILLED HEADS, COLLAR SCREWS.

	Diameter of Collar.	¼	11/32	7/16	½	5/8	11/16	13/16	15/16	1	1¼
	Diameter of Screw.	1/8	3/16	¼	5/16	3/8	7/16	½	9/16	5/8	¾
Length under Head to Point.	¾	2.50	2.80	3.10	3.75	4.40	5.00	6.25			
	1	2.80	3.10	3.40	4.05	4.70	5.30	6.60	8.25		
	1¼	3.10	3.40	3.70	4.35	5.00	5.60	7.00	8.60	11.25	
	1½	3.45	3.70	4 00	4.70	5.30	5.95	7.40	9.00	11.90	15.00
	1¾		4.05	4.35	5.05	5.65	6.35	7.80	9.45	12.60	15.60
	2			4.70	5.45	6.25	6.85	8.40	10.00	13.35	16.25
	2¼				5.95	6.85	7.40	9.00	10.60	14.15	17.10
	2½					7.50	8.10	9.60	11.25	15.00	18.00
	2¾						8.75	10.30	11.90	15.90	19.00
	3							11.00	12.60	16.85	20.00
Threads to inch		40	30	20	18	16	14	12 or 13	12	11	10
Add for each ¼ inch		30	40	50	60	80	1.00	1.30	1.60	2.00	2.40

Dis., 25%.

MILLED FROM SOLID BAR.

Fillister. Bevel Head. Button Herd.

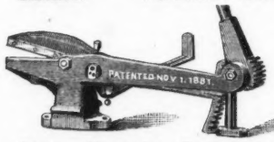
	Diam. Head	3-16	¼	3/8	7-16	9-16	5/8	¾	13-16	7/8	1
	Length Head	1/8	3-16	¼	5-16	3/8	7-16	½	9-16	5/8	¾
	Diam. Screw	1/8	3-16	¼	5-16	3/8	7-16	½	9-16	5/8	¾
Length under Head.	¾	2.00	2.25	2.50	3.00	3.50	4.00	5.00			
	1	2 25	2.50	2.75	3.25	3.75	4.25	5.30	6.60		
	1¼	2.50	2.75	3.00	3.50	4.00	4.50	5.60	6.90	9.00	
	1½	2.75	3.00	3.25	3.75	4.25	4.75	5.90	7.20	9.50	12.00
	1¾		3.25	3.50	4.00	4.50	5.00	6.20	7.50	10.00	12.50
	2			3.75	4.35	5.00	5.50	6.75	8.00	10.75	13.00
	2¼				4.75	5.50	6.00	7.25	8.50	11.50	13.75
	2½					6.00	6.50	7.75	9.00	12.00	14.50
	2¾						7.00	8.25	9.50	12.75	15 25
	3							8.75	10.00	13.50	16.00
Threads to inch.		40	30	20	18	16	14	12	12	11	10

Head on Bevel and Button Head Screws, 1-16 larger in diameter than above specifications.
Price, according to size of head.
Discount, 50%; case hardened, 45%; case hardened and polished, 35%.

Slate Roofing.

F. o. b. New York. Stowage allowed.
Purple and Green, per 100 feet sq.....$4.50
Dark blue, per 100 feet sq..... 4.10
Sizes, 24 × 12 = 115 to sq., 650 lbs. weight.
Sizes, 20 × 10 = 170 to sq., 650 lbs. weight.

Shears. The Patent "Eureka.'



No. 1 cuts round metal up to ¼ in., steel to ⅛, $12.

No. 2 cuts round metal up to ⅛ in., steel to 3-16, $20.

Discount, 25%.

Soups (French). Franco-American Brand

	Per dozen. In Cans—Quarts.	Pints.	In Glass. 1½ pt.
Green turtle	$8.00	$4.32	$9.00
Terrapin			
Chicken	3.75	2.25	
Mulligatawny			
Mock turtle			
Ox tail			
Consommé			4.50
Tomato			
Julienne			
Printanier	3.50	2.10	
French bouillon			
Mutton broth			
Vegetable			None in glass.
Beef			
Pea			

Packed in cases of..... 2 doz. 4 doz. 1 doz.
Regular Assorted Cases. In Cans—Quarts.
2 Chicken, 1 Mulligatawny, 3 Mock Turtle, 3 Ox Tail, 2 Consommé, 2 Tomato, 3 Julienne, 1 Printanier, 1 Mutton Broth, 1 Vegetable. 1 Beef, 2 French Bouillon, 2 Pea. Per doz., $3.55.
In Glass.
1 Chicken, 1 Mulligatawny, 2 Mock Turtle, 1 Ox Tail, 2 Consommé, 2 Tomato, 1 Julienne, 1 Printanier, 1 Mutton Broth.
Terms cash. Discounts: 5% for lots of 10 cases, 10% for lots of 25 cases, 15% for lots of 50 cases.

Spades and Shovels.

The D. F. Jones Mfg. Co., of Gananoque (Ld.).

JONES'

Patent plain black solid cast-steel shovels and spades.

No.		Per Doz. No. Black.	Per Doz. Pol's'd
20.	D. or long handle sq.-point shovels. 2	$15.50	$16.50
21.	" " " " " 3	16.25	17.25
22.	" " " " " 4	17.00	18.50
23.	" " " " " 6	17.50	19.00
24.	" " " " charcoal. 8	20.50	22.00
25.	" " " round-point shovels. 3	16.25	17.25
28.	" " " spades..... 2	16.00	17.00
29.	" " " " 3	16.50	18.00
32.	D. handle square-point molders' shovels..... 2	.....	17.00
33.	D. handle square point railroad, extra heavy..... 2	15.75	
34.	D. handle round point railroad, extra heavy..... 3	16.50	
35.	L. handle round point shovel, with foot cap..... 2	16.00	17.00

GRAY'S

Patent plain back solid-steel shovels and spades.

50.	D. or long handle sq.-point shovels. 2	$12.00	$13.00
51.	" " " " " 3	12.75	14.00
52.	" " " round point " 3	12.75	14.00
55.	D. handle spades..... 2	12.25	13.25
56.	" " " 3	13.00	14.25

SCOOPS.

Jones' patent plain back solid corrugated scoops.

90.	D. or long handle solid cast steel... 2	$13.50	$14.50
91.	" " " " " ...4	14.50	15.50
91½.	" " " " " ...6	16.50	17.50

Jones' riveted scoops.

92.	Cast steel D. or long handle.....2	13.50	14.50
93.	" " " " 4	14.50	15.50
94.	" " " " 6	16.50	17.50
		Half polished.	
95.	" " " 8		$20.00
96.	" " " 10		22.50
97.	" " " Locomotive or coal (heavy).....6	17.50	
98.	" Long or D. handle for salt (heavy).....6	17.50	
99.	" D. handle flour and house furnace.....	10.50	
100.	" D. handle r'd-pt. for coal (extra heavy).....6	20.00	
		Polished.	
101.	" ash pit, furnace L. handle.....2		13.00
102.	" " " 32 in. D..2		13.50
103.	" " " 42 " iron D. handle.....2		14.00

Discount on shovels and spades, 50 and 10.
" " scoops, 50.
Boxed f.o.b. New York, Boston on Montreal.
The solid shovels, spades and scoops are made from the bar, by a recent patent process, the blade and strap being in one piece, not welded. All goods are American patents.

Stencil Inks.

S. H. QUINT & SON.

Black.

No.	Per can.	Per cake.	No.	Per can.	Per cake.
1.....	7 cents	3 cents	3.....	20 cents.	12 cents
2.....	10 "	5 "	4.....	30 "	20 "

Blue.

1.....	10 cents.	6 cents	3.....	30 cents.	22 cents
2.....	15 "	9 "	4.....	50 "	40 "

Red and Green.

1.....	12 cents	8 cents	3.....	50 cents.	42 cents
2.....	20 "	15 "	4.....	90 "	80 "

Per doz. cans or cakes, net, per gross, 10% less.

Indelible Ink.

Small bottles per	100	$2.75
" "	500	12.00
" "	1,000	20.00

STENCIL COMBINATIONS.

Contains Alphabet, Figures, Brush. and Ink.

½ inch, per doz		$5.00
¾ "	"	5.40
1 "	"	5.75
1¼ "	"	7.50
1½ "	"	8.40
2 "	"	10.00
2½ "	"	15.00

Dis., 10%.

Packings.

SHELDEN'S PATENT.

For Steam, Air, Water and Ammonia.
With Rubber Core, 60 cents per lb.
Dis., 25 and 5%.
With canvas core, 50 cents per lb.
Dis., 30 and 5%.

Tools.

ARTISANS.

Chisel (Mason).

Stone, 5 and 8c. lb., net.

Mill Picks.
Cast steel, 2 to 3 lbs., $22 per doz.
Dis., 60 and 5%.

Stone Axes, Cast Steel.

All sizes, 50c. per lb.

Dis., 70 and 10%.

Five lbs. and over, 40c.; with teeth, 45c.; 3 to 5 lbs., 45c.; with teeth, 50c.; under 3 lbs., 50c.; with teeth, 55c.
Nos. 40 and 41, spalling or stone hammer, 5 lbs. and over, 36c.; 3 to 5 lbs., 40c.; under 3 lbs., 45c. per lb.

Nos. 40 and 41, spalling hammers, 9 to 20 lbs., steel face, per lb., 17c. Dis., 70 and 10%

Ship or Top Mauls, Steel Face, 4 to 8 lbs., 28c. per lb.

Dis., 50, 10 and 5%.

Steel Wedges, wood, 1st qual., 5c. lb.

Cooper Frocs.

8 in..	℔ doz. $13.00
10 in..	℔ doz. 13.50
12 in..	℔ doz. 14.00
14 in..	℔ doz. 14.50
16 in..	℔ doz. 15.00

Discount, 60%.

60 days, 2% 10 days.

Vise.

No 1. Solid Box Vises.

		Each.
No. 25, 3⅜ in.	Jaw	$12.00
" 30, 3½	"	11.00
" 55, 3⅞	"	10.00
" 40, 4	"	10.50
" 45, 4¼	"	11.00
" 50, 4¼	"	11.50
" 55, 4½	"	12.00
" 60, 4½	"	13.00
" 65, 4¾	"	14.00
" 70, 5	"	15.00
" 75, 5	"	16.00
" 80, 5¼	"	17.50
" 85, 5¼	"	18.50
" 90, 5½	"	20.00
" 95, 5¾	"	21.00
" 100, 6	"	22.00
" 105, 6	"	23.00
" 110, 6¼	"	24.00
" 115, 6¼	"	25.00
" 120, 6½	"	26.00
" 125, 6½	"	27.50
" 130, 6¾	"	29.00

		Each.			Each.
No. 135, 6¾ in.	Jaw	$31.50	No. 170, 7¼ in.	Jaw	$44.50
" 140, 7	"	33.00	" 180, 8	"	47.00
" 145, 7	"	35.00	" 190, 8	"	53.00
" 150, 7	"	36.00	" 200, 8	"	56.00
" 160, 7¼	"	41.50			

Dis., 60 and 10%.

MINERS.

Coal Picks.

No.		Per doz.
16, Weight, 2	lbs	$8.50
16, "	2½ "	9.00
16, "	3 "	9.50
16, "	3½ "	10.00
16, "	4 "	10.50
16, "	4½ "	11.00
16, "	5 "	11.50
16, "	5½ "	12.00
16. "	6 "	12.50
16, "	6½ "	13.00
16, "	7 "	14.00

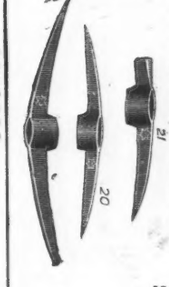
Packages charged at cost.
Dis., 60%.

Adze Eye Coal Picks.
Same list and dis. as No. 16.

Anthracite Coal Picks.
Same list and dis. as No. 16.

Stone Picks, per doz.
No. 18, 6 to 7 lbs... $16.50.
No. 18, 7 to 8 lbs... 17.50.
No. 18, 8 to 9 lbs... 18.50.
Dis., 60 and 5%.

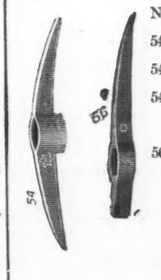
Adze Eye Miners' Picks—Surface, Drifting and Poll.



No.		per doz.
19, Surface.	No. 1, 4 lbs	$14.00
19, "	No. 2, 4½ "	15.00
19, "	No. 3, 5 "	16.00
19, "	No. 4, 5½ "	17.00
19, "	No. 5, 6 "	18.00
19, "	No. 6, 6½ "	19.00
19, "	No. 7, 7 "	20.00
20, Drifting,	No. 1, 3 "	12.50
20, "	No. 2, 4 "	14.00
20, "	No. 3, 4½ "	15.00
20, "	No. 4, 5 "	16.00
20, "	No. 5, 6 "	17.50
21, Poll,	No. 1, 3½ "	15.00
21, "	No. 2, 4 "	16.00
21, "	No. 3, 4½ "	17.00
21, "	No. 4, 5 "	18.50
21, "	No. 5, 6 "	20.00
21, "	No. 6, 6¾ "	21.50

Dis., 60, 10 and 5%.

Ore Picks.



No.	
54, Adze Eye,	5 to 6 lbs.... ℔ doz. $12.00
54, "	6 to 7 " .... " $13.00
54, "	to 8 " .... " $14.00

56, Steel Lake Superior Mining Pick

(Special Price and Quality.)

Dis, 60 and 10

Tamping Picks.

Adze eye, 6 to 7 lbs., per doz., $17.
Adze eye, 7 to 8 lbs., per doz., $18.
Adze eye, 8 o 9 lbs., per doz., $19.
Hunt eye, 6 to 7 lbs., per doz., $17.
Hunt eye, 7 to 8 lbs., per doz., $18.
Hunt eye, 8 to 9 lbs., per doz., $19.
Dis., 60 and 10%.

Steel Face Sledges.

No. 34. Smiths' sledges, 6 to 30 lbs., steel face, 17c. per lb.

No. 35. Stone sledges, 6 to 30 lbs., steel face, 17c. per lb.

No. 36. Striking sledges, 6 to 30 lbs., steel face, 17c. per lb.

No. 37. Coal sledges, 5 to 10 lbs., steel face, 18c. per lb.

Cast Steel Sledges.

No. 34. Blacksmiths' sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.

No. 35. Stone sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.

No. 36. Striking sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.

No. 37. Coal sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.

No. 43, hand drilling hammer, 5 lbs. and over, 36c.; 3 to 5 lbs., 40c.; under 3 lbs., 45c. per lb.

Dis., 70 and 10%.

Steel Face Hammers.

No. 43, hand drilling hammers, 2 to 5 lbs.; No. 45, napping hammers, 2 to 5 lbs.; No. 39, mason hammers, 3 to 8 lbs.; No. 42, smiths' hand hammers, 2 to 5 lbs.; No. 44, smiths' striking hammers, 2 to 5 lbs., all steel face, per lb., 26c. Dis., 70 and 10%.

Cast Steel.

No. 42, blacksmiths' hand hammer, 5 lbs. and over, 30c.; 3 to 5 lbs., 34c.; under 3 lbs., 45c. per lb.

No. 44, drilling or striking hammer, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.

No. 45, napping hammer, 5 lbs. and over, 30c.; 3 to 5 lbs., 35c., under 3 lbs., 45c. per lb.

Dis., 70 and 10%.

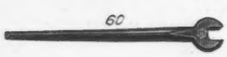
RAILROADS.

Railway Track Punch

Round Point.

15c. lb., net.

Track Wrench.



7¾c. lb., net.

Rail Fork.

9c. lb., net.

Crow Bars.

Wedge Points, 3⅝c. lb., net.

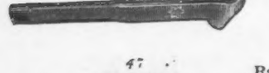
Pinch Point, 3 1/16c. lb., net.

65 Tamping Bar, 6c. lb., net.

66 Claw Bar, 7c. lb., net.

Railroad Spike Mauls, 6 to 16 lbs., Steel Face 18c. lb.

Dis., 50, 10, and 5%.



Steel Track Chisel, 15c. per lb., net.

Railroad or Clay Picks.

No.			Per doz.
11,	Adze eye,	4 to 5 lbs.	$11.00
11,	"	5 to 6 "	12.00
11,	"	6 to 7 "	13.00
11,	"	7 to 8 "	14.00
11,	"	8 to 9 "	16.00
11,	"	9 to 10 "	18.00
12,	Hunt eye,	4 to 5 "	11.00
12,	"	5 to 6 "	12.00
12,	"	6 to 7 "	13.00
12,	"	7 to 8 "	14.00

Dis., 60 and 10%.

Mattocks—Price per doz.

2, Adze Eye, Long Cutter, 6 lbs., $16.00.

3, Adze Eye, Short Cutter, 5½ lbs., $15.50.

2, Adze Eye, Long Cutter, Light, $15.00.

3, Adze Eye, Short Cutter, Light, $15.00.

4, Hunt Eye, Long Cutter, 6 lbs., $16.00.

5, Hunt Eye, Short Cutter, 5½ lbs., $15.50.

Adze Eye Pick Mattocks.....$16.

Hunt Eye Pick Mattocks.....$16

Dis., 60 and 10%.

Grub Hoes.

Western Pattern, No. 0, 3 lbs., ₱ doz., $10.50.

Western Pattern, No. 1, 3½ lbs., ₱ doz., $11.

Western Pattern, No. 2, 4 lbs., ₱ doz., $11.50.

Western Pattern, No. 3, 4½ lbs., ₱ doz., $12.

Baltimore Pattern, No. 1, 3½ lbs., ₱ doz., $11.

Baltimore Pattern, No. 2, 4½ lbs., ₱ doz., $11.75

Baltimore Pattern, No. 3, 5 lbs., ₱ doz., $12.75.

Baltimore Pattern, No. 4, 5¾ lbs., ₱ doz., $13.75.

Dis., 60 and 10%.

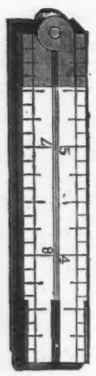
Shovels. C. S., long handle, round point.

Ames'.	Hobart's	Day's.
No. 1....11.50	8.00	8.00
2....11.50	8.00	8.00
3....12.25	8.50	8.50

D. Handles round point.

2....12.00	8.50	8.50
3....12.50	9.00	9.00

Dis., 20, 10 and 5 %.



Tools, Carpenters'.

BOXWOOD RULES.

Two feet, four-fold, 1 inch wide.

Plate.	Middle.	Edge.	Bound.
Round joint.....	$4	...	...
Square "	5	$7	$15
Arch "	6	8	16

Two feet, four-fold, 1⅜ inches wide.

Plate.	Middle.	Edge.	Bound.
Square joint.....	$7	$9	$18
Arch "	9	11	20

Two feet, two-fold, 1½ inches wide.

Square joint.	Arch.	Arch Bound.
$5	$7	$16
12	14	24

Gunter's Slide.

Dis., 80, 10 and 10%.

LEVELS.

	10 to 16 in.	18 to 24 in.
Arch top plate, 2 side views..	$9.00	$12.00

PLUMBS AND LEVELS.

Arch top plate, 2 side views.

	12 to 18 in.	18 to 24 in.	24 to 30 in.
Polished.....	$14.00	$16.00	$18.00
Mahogany.....	.....	16.50	22.50
Mahogany tp'd and lp'd	27.00	.....	.....
Polished and l pped.....	.....	.....	24.00
Polished and tipped.....	.....	.....	28.00
Polished, lip'd and tip'd	.....	.....	35.00

	in.	
Mason's level, 2 plumbs, polished,	36,	$30.00
Mason's level, 2 plumbs, p'd and t'd,	36,	36.00
Mason's level, 2 plumbs, polished,	42,	36.00

PATENT ADJUSTABLE PLUMBS AND LEVEL.

Arch Top plate, 2 side views	26 to 30 in.
Polished and lipped.....	$27.00
Polished and tipped.....	30.00
Polished, lipped and tipped.....	39.00
Mahogany.....	27.00
Mahogany, lipped.....	33.00
Mahogany, lipped and tipped.....	48.00
Polished, triple stock, lipped and tipped.....	48.00
Mahogany " " "	60.00
Rosewood, lipped and tipped.....	90.00

Dis., 70, 10, 10%.

POCKET LEVELS.

Iron top, Japanned.....	2 50
Brass top.....	3.00

Dis., 70, 10, 10%.

SCREWDRIVERS.

Varnished handles, pat. metallic fastening.

Size 1½, $1 per dozen; 2, $1.50; 3, $2; 4, $2.50; 5, $3; 6, $3.50; 7, $4; 8, $4.75; 10, $6; $12, $8.

Dis., 75 %.

PLANES, BAILEY'S PATENT IRON.

Withipat. lateral adjustment.

Smooth, 8 in. × 1¾ in., $3; 9 in. × 2 in., $3.25; 10 in. × 2⅜ in., $3.75 each.

Jack, 14 in. × 2 in., $3.75.

Fore, 18 in. × 2⅜ in., $4.75

Jointer, 24 in. × 2⅝ in., $6.50 each.

Dis., 40, 10 and 10 %.

BAILEY'S PATENT WOOD PLANES.

Smooth.		Handle smooth.
9 × 8¾ in.	8 × 2 in.	9 × 2 in.
$2	$2	$2.50 each

Jack.	Fore.	Jointer.
15 × 2⅛ in.	20 × 2⅜ in.	26 × 2⅝ in.
$2.50	$2.75.	$3.25 each

Dis., 40, 10 and 10%.

STANLEY IRON BLOCK PLANES.

3½ × 1 in. 20c.

5½ × 1¼ in. 40c.

7½ × 1¾ in. 60c. each.

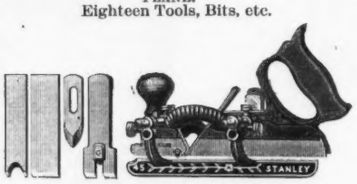
ADJUSTABLE.

5½ × 1¼ in. 60c.

7½ × 1¾ in. 85c. each.

STANLEY'S BEADING, RABBET, SLITTING AND MATCHING PLANE.

Eighteen Tools, Bits, etc.



$8 each. Dis., 20, 20 and 10%.

STANLEY "ODD JOBS."

Embraces in combination with ordinary Carpenters' Rule:

010 Try square.
020 Mitre square.
030 T—— square.
040 Marking gauge.
050 Mortise gauge.
060 Depth gauge.
070 Mitre level.
080 Spirit level and plumb.
090 Beam compass.
0100 Inside square for making boxes and frames.

Price 75 cents.
Dis., 20, 10 and 10%.

TACK HAMMERS.

	Doz.
Magnetic, small.....	$1.25
Medium.....	1.50
Large.....	1.75

Discount, 30, 10, 10%.

MALLEABLE IRON.

Inlaid Handle.

Per Doz.....$2.50

Discount, 30, 10, 10%.

STEAK HAMMERS.

Japanned.....	$2.25
X Plated.....	3.00

Discount, 30, 10, 10%.

Trucks.

New York Pattern.

Size.	Length of hdles. Ft.	In.	Width at nose. Inches.	Width at upper bar. Inches.	Size of wheel. Inches.	Price.
No. 0	3	6½	12	13¼	6½ × 1¾	$4.50
No. 1	4	1	13⅞	15½	6½ × 1¾	4.85
No. 2	4	5	15	16½	7¾ × 1⅞	6.00
No. 3	4	8	16	17¾	8¾ × 2¼	7.00
No. 4	5	0	16¼	17¾	9¾ × 2¼	8.00
No. 5	5	4	17¼	18⅞	10¾ × 2¾	9.50

Discount 50%.

Special net prices on quantity orders.

Tuyeres.

No. 2.	No. 4.
$25.00	$35.00 per doz.

20 % dis.

Valves.

Brass Globe and Angle Valves.

Size, inches	⅛	¼	⅜	½	¾	1
Star globe and angle valves	$0.80	$0.85	$0.90	$1.20	$1.55	$2.00
Star globe and angle valves, heavy patterns	...	...	...	1.50	1.95	2.80
Extra heavy Star and Lion patterns	...	...	...	2.00	2.60	3.60
All brass, yoke top	...	...	...	...	...	3.75
Cross valves	...	1.15	1.25	1.50	2.00	2.50
Star check valves	.70	.70	.75	.95	1.20	1.65
do. heavy pattern	...	...	...	1.15	1.50	2.00
Crescent globe and angle valves	.60	.60	.75	1.00	1.35	1.80
Crescent hose valves	...	...	...	...	...	...
check valves	.50	.60	.85	1.15	1.55	
Vertical check v'lv's	.50	.60	.85	1.15	1.55	
Jenkins globe and angle valves	1.10	1.25	1.60	2.20	2.80	
Jenkins check valv's	1.10	1.20	1.30	1.90	2.60	
Gate valves, Chapman	...	...	...	1.30	1.75	2.25
Gate valves, other makes	...	...	1.00	1.20	1.75	2.50
Brass safety valves	2.00	2.25	2.75	3.50	5.00	
Brass butterfly v'lv's	...	...	...	...	...	3.50

Size, inches	1¼	1½	2	2½	3
Star globe and angle valves	$3.00	$4.00	$6.50	$12.50	$19.00
do. heavy pattern	3.95	5.30	8.35	14.00	22.00
Extra heavy Star and Lion patterns	5.40	7.20	10.80	18.20	28.60
All brass, yoke top	5.00	7.00	10.00	18.00	30.00
Cross valves	3.50	5.00	8.00	16.00	24.00
Star check valves	2.50	3.25	5.00	11.00	15.00
do heavy pattern	3.00	4.00	6.50	12.50	17.00
Crescent globe and angle valves	2.80	3.90	5.90	11.25	16.00
Crescent hose valves	4.00	5.50	7.00	10.00	....
" check valves	2.30	3.25	5.20	10.00	14.00
Vertical check valves	2.30	3.25	5.20	10.00	14.00
Jenkins globe and angle valves	4.00	5.50	8.00	15.75	22.00
Jenkins check valves	3.60	5.00	7.50	13.50	20.50
Gate valves, Chapman	3.25	4.25	6.25	11.50	16.00
" " other makes	3.50	5.00	7.50	15.00	22.00
Brass safety valves	7 00	8.50	12.00	20.00	30.00
Brass butterfly valves	4.50	5.50	8.00	11.00	16.00

Pressure Regulating.

Mason Regulator Co.

Size pipe.	Price.	Size pipe.	Price.	Size pipe.	Price
1 inch,	$22.	1¼ inch,	$28.	1½ inch,	$35.
2 "	44.	2½ "	57.	3 "	72.

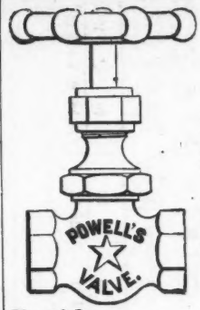
Ludlow Valve Co.
Double Gate Brass Valves.
Gland in packing box.

Size.	Screw socket.	Flange.	Diameter of Standard Flange.	Face to face of Screw socket	Face to face of Flanges.	Extra for slide stem and lever subject to discount.
In.	$	$	In.	In.	In.	
½	1.25	.....	.....	2¼	.....	$1.00
¾	1.65	.....	.....	2½	.....	1.00
1	2.15	.....	.....	2⅞	.....	1.00
1¼	3.15	.....	.....	3⅜	.....	1.00
1½	4.25	.....	.....	3¾	.....	1.00
2	6.25	11.50	6	4½	4⅝	1.00
2½	11.50	18.00	6½	4 13-16	5⅜	1.25
3	16.00	22.00	7	5	6¼	1.25
3½	21.00	31.00	7½	.....	.....	1.25
4	35.00	43.00	9	.....	7 1-16	1.25
5	52.00	64.00	10	.....	.....	1.25
6	78.00	90.00	11	.....	9	1.25
8	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....
12	.....	.....	.....	.....	.....	.....

Rubber-Faced Slide Gate Fire Hydrant.
See cuts on pages 19 and 20.

Diameter of pipe connection.	Diameter of stand pipe.	Diameter of seat ring.	One 2½ nozzle.	Two 2½ nozzles.	Three 2½ nozzles.	Four 2½ nozzles.	Six 2½ nozzles.	One steamer nozzle.	One steamer and one 2½ nozzle.	One steamer and two 2½ nozzles.	Frost case, standard length.
Inches.	Inches.	Inches.									
3 or 4	4⅝	3	$28	.....	.....	.....	.....	.....	.....	.....	$4.50
3-4-6	5¾	4	31	$33.00	$35.00	.....	.....	$33.00	$35.00	$37.00	5.00
4 or 6	7	5	.....	38.50	40.50	.....	.....	38.50	40 50	42.50	6.50
6 or 8	8	6	.....	49.00	51.00	.....	.....	49.00	51.00	53.00	7.50
8 or 10	10	8	.....	.....	.....	.....	.....	.....	.....	.....	.....

For each 6 inches more or less than standard length of stand pipe, add or deduct from list.	For each 6 inches more or less than standard length of frost case, add or deduct from list.	Extra charge for hub.	Independ't nozzle gates each.
$0.60	$0.44	.....	.....
.75	.50	6 in. $0.50	$3.50
.85	70	No ch'ge	3.75
1.00	.90	8 in. $1.25	3.75
.....	.....	.....	4.50



Star Radiator Valves, with Brass T Handles or Wood Wheels.

Size, inches	½	¾	1
Plain brass	$1.60	$2.00	$2.50
Plated trim'gs.	1.80	2.25	2.80
Rough & Plat'd	2.00	2.45	3.05
Finish'd & P'l't.	2.50	3.00	3.65

Size, inches	1¼	1½	2
Plain brass	$3.60	$4.80	$7.50
Plated trim'gs.	3.95	5.20	8.00
Rough & Plat'd	4.20	5.50	8.50
Finish'd & P'l't.	4.95	6.50	9.75

Dis., 40, 10 and 5%.

Varnish.

Edward Smith & Co.

For Finishing Coats.	gal.
Wearing body varnish	$5.50
Medium drying body	5.50
One coat coach varnish	4.50
Wearing carriage	4.50
Heavy gear varnish	4.00
Coach body "	4.05
No. 1 coach "	2.2

For Under Coats.		For Inside Work.	
Hard drying body	$4.50	Black rubbing varnish	$4.00
Rubbing body varnish	4.00	Priming (1st coat)	2.50
Quick rubbing "	3.50	Filling (2d coat)	2.50
		Rough stuff	2.50
Best flowing varnish	$4.50	Hard oil finish light	$2.75
Best polishing "	4.50	" dark	2.25
Cabinet "	3.00	White copal	4.00

Dryers.		Preservative Coatings.	
Japan gold size	$3.50	Brown japan	$1.25
Coach japan	1.75	Liquid dryer	1.25
Spar coatings	$4.00	Exterior car coating	$4.00
I. X. L. No. 1	2.50	Interior car coating	3.25
I. X. L. No. 2	4.00	Locomotive coating	4.00
Floor finish	2.50		

Discount, 40 per cent. f.o.b. N. Y.
Discount, 35 per cent, f.o.b. N. Y.

Wheelbarrows.

Climax Bolted Barrow, with Wood Wheel per doz. $22.50.
1½ tire of iron.
Common Nailed Barrow per doz. $18.50.
" Bolted " " " 18.75.
Lansing's Patent Iron-Bolted Barrow, per doz., $25.50
Capital Patent Bolted Dirt " " " 30.00
Red oak or Government " " " 40.50
Wharf " " " 72.50
Mortar " " " 30.00
Bent Handle Stone " " " 48.00
Coal or Ore " " " 31.50
Pig Metal or Casting " " " 40.50
Brick Yard 20 inch Iron Wheel " each 10.50
Globe Patent Bolted Garden Barrow, Box 30 by 24 by 12 deep, wood wheel } per doz., 42.50.
Capita Patent Barrows
With Iron Tray, A, per doz., ... $39.00
" " " B, " " 42.00
The Leader Iron and Steel Barrows.
Gas-pipe Legs and Handles in one price.
No. 1 Tray of 16 iron, capacity 3 cu. ft. of earth, each $12.
No. 2 " " 14 " " 5 " " " "
or 250 lbs. of coal ..... " 15
3 Galvanized 18 iron, capacity same as No. 2 ..... " 15

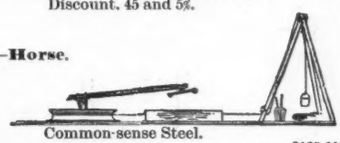
Whiffletree.

Willson spring (Jeffery Manufacturing Company).

	Single.	Double.
No. 1, 34 or 36 inches long	$1.25	$2.50
No. 2, " " "	1.40	2.75
No. 3, " " "	1.50	3.00
No. 4, " " "	1.65	3.25

Including either steel hooks or rings'
Discount, 45 and 5%.

Whims—Horse.



Common-sense Steel.
F. O. B. $125.00
Dis., 25%.

Wind Mills.

10 ft. pumping	....	$75
12 ft. "	....	95
14 ft. "	....	140
16 ft. "	....	225

Plus cost of packing.
Dis., 50 per cent.

Wick.

Baltimore Twine & Net Co.

Braided, all kinds, from	.....	60c. to $1.00

LAMP.

0, or E	per gross	$0.40
1, or A	"	.60
2, or B	"	.75
3, or D	"	1.30
Brilliant, Argand and Crystal light	"	1.60
Deitz	"	.70
B—Double Thick	"	2.00
Pet Circular	"	.33
German Pet	"	.55
Moehring	"	3.00
Mann's Monarch	"	2.00
Dual	"	2.00
Duplex and Oxford	"	3.00
Wide Awake and Nutmeg	"	.40
Tom Thumb, Round and Flat	"	.25
Nos. 1 and 2 German Student	"	1.10
BB, or Bonanza	"	2.00
AA	"	1.50
Above, in 32-yard pieces	as per gross	
Round Fluid	per doz.	$ .30
Wick in Boxes	3 cents extra	

Dis., 60, 10, 5 and 3%.

CANDLE.

13 to 20 cents.

Wire Cloth.

Newark, O., Wire Cloth Co.
Brass and Copper Wire Cloth.

No. Mesh.		Price per foot.	No. Mesh.		Price per foot.
2 from No. 10	wire	$2 50	20 from No. 26	wire	$.80
3 " 11	"	.... 2.50	22 " 27	"	.... .80
4 " 12	"	.... 2.50	24 " 28	"	.... .80
5 " 13	"	.... 2.50	30 " 30	"	.... .65
6 " 14	"	.... 2.50	40 " 32	"	.... .70
8 " 16	"	.... 2.50	50 " 34	"	.... .75
10 " 18	"	.... 2.00	60 " 35	"	.... .78
12 " 19	"	.... 2.00	70 " 37	"	.... .70
14 " 22	"	.... 1.10	80 " 38	"	.... .90
16 " 24	"	.... .80	90 " 39	"	.... 1.10
18 " 25	"	.... .80	Dis., 60%.		

Wire Goods.

Fly Traps. Per gross.
Paragon $18.00
Balloon 15.00

Woodenware.

MALLETS.

Round Hickory.

	Per doz.	Barrels contain about.
No. 1, 2 to 2½ in.	$1.25	10 dozen.
" 2, 2½ to 3 "	1.75	8 "
" 3, 3 to 3½ "	2.25	5 "
" 4, 4 "	2.50	4 "

Round Lignumvitæ.

	Per doz.	Barrels contain about.
No. 1, 3 inches	$3.00	6 dozen.
" 2, 3½ "	4.00	5 "
" 3, 4 "	5.00	4 "
" 4, 5 "	6.00	3 "

ROLLING PINS.

Packed in crates of one gross, and in boxes of one dozen. Solid and Loose or Revolving handles. Per dozen, $1.00.

SHOVELS.
Grain Scoops or Shovels (Wood).

Small size, price per dozen, $7.
Medium size, price per dozen, $8.
Large size, price per dozen, $9.
Made out of selected Hardwood, Maple, Beach and Birch.
Small, Medium and Large Sizes; used for Grain, Malt, Potatoes, Fruit, etc.
Long Handle Scoops, 4 feet long, $12 per dozen.

MASHERS.
Beefsteak.

Price, 70c. per dozen; barrels contain about 12 dozen.
Made out of Sugar Maple.

Potato.

Small size, 50c. per dozen; barrels contain about 30 dozen.
Medium size, 60c. per dozen; barrels contain about 15 dozen.
Large size, 70c. per dozen; barrels contain about 11 dozen.
Made out of Hard Sugar Maple and Wax Polished.

Wringers and Washing Supplies.

Royal Keystone cog wheel, 10 by 1¾ rolls, $36 per doz.
No. 10, wood frame cog wheel, 10 by 1¾ rolls, $24.50.
No. 16, wood frame cog wheel, 11 by 1¾ rolls, $29.
No. 18, wood frame cog wheel, 11 by 1⅞ rolls, $33.50.
No. 20, wood frame cog wheel, 11 by 2 rolls, $39.50.
No. 22, wood frame cog wheel, 12 by 1⅞ rolls $39.50.
No. 24, wood frame cog wheel, 12 by 2 rolls, $48.50.
No. 11, iron frame cog wheel, 10 by 1⅝ rolls, $20.

No. 2, iron frame cog wheel, 10 by 1¾ rolls, $24.
Solance iron frame (Eureka Pat.), 10 by 1¾ rolls, $20.
Solance iron frame (Eureka Pat.), 11 by 1¾ rolls, $24.50
F.o.b. cars at works; 60 cents doz extra f.o.b. New York.
Keystone Double Bench Wringer.
Rolls, 10 by 1¾, $36.50 per doz.
Made to fold.
Folding Double Folding Wash Bench, packed 6 in crate per doz., $14.

Adams Ironing Table, per doz	$15.00
Keystone Washing Machines, per doz	24.00
Complete " " "	13.50
People's " " "	13.50
Lovell " " "	13.50

Net prices.
Cabinet Clothes Driers, per doz., $21.00 net,
Excelsior Clothes Horse, per doz., $6.00 net.

Reversible Clothes Horse.

	High.	Per doz.	
A	3 ft	$14.00	Dis., ash, 50 and 10%.
B	3 ft. 10 in.	16.00	
C	4 ft. 10 in.	18.00	
D	5 ft. 10 in.	20.00	Basswood, 60 and 10%.

Nursery Reversible Clothes Horse.

2 section, 3 ft. high, per doz	$9.00
3 " " "	12.00
4 " " "	16.00

Black Walnut Bronze Tips and Hinges. Dis., 30%.

WASHBOARDS.

The following prices are on orders of not less than 25 dozen of one kind, or an assortment.

Wilson, one rubbing surface, per doz., $1.40.
Saginaw, one rubbing surface, per doz., $1.25.
Exchange, one rubbing surface, per doz., $1.10.
Wilson, two rubbing surface, per doz., $2.
Saginaw, one rubbing surface, per doz., $1.75.
Crescent, one rubbing surface, per doz., $2.25.
Shamrock, one rubbing surface, per doz., $2.

Rubbing surface of the two latter is solid sheet of zinc, without wood backs.

We invite manufacturers to send us catalogues, price lists, with export discounts, and we will forward the same to our correspondents free of charge.

We also offer our services to foreign correspondents who desire to purchase American goods, and shall be pleased to furnish them, without charge, information concerning American manufactures of every kind.

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TABLE CONVERTING AMERICAN INTO ENGLISH MONEY.

American cents	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
English money	d. ½	d. 1	d. 1½	d. 2	d. 2½	d. 3	d. 3½	d. 4	d. 4½	d. 5	d. 5½	d. 6	d. 6½	d. 7½	d. 8	d. 8½	d. 9	d. 9½	d. 10	d. 10½	d. 11	d. 11½	s. d. 1	s. d. 1 ½	s. d. 1 1	s. d. 1 1½	s. d. 1 2	s. d. 1 2½	s. d. 1 3	s. d. 1 3½	s. d. 1 4	s. d. 1 4½
American cents	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
English money	s. d. 1 5	s. d. 1 5½	s. d. 1 6	s. d. 1 6½	s. d. 1 7	s. d. 1 7½	s. d. 1 8	s. d. 1 8½	s. d. 1 9	s. d. 1 9½	s. d. 1 10	s. d. 1 10½	s. d. 1 11	s. d. 1 11½	s. d. 2	s. d. 2 ½	s. d. 2 1	s. d. 2 1½	s. d. 2 2	s. d. 2 2½	s. d. 2 3	s. d. 2 3½	s. d. 2 4	s. d. 2 4½	s. d. 2 5	s. d. 2 5½	s. d. 2 6	s. d. 2 6½	s. d. 2 7	s. d. 2 7½	s. d. 2 8	s. d. 2 8½	s. d. 2 9
American cents	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
English money	s. d. 2 9½	s. d. 2 10	s. d. 2 10½	s. d. 2 11	s. d. 2 11½	s. d. 3	s. d. 3 ½	s. d. 3 1	s. d. 3 1½	s. d. 3 2	s. d. 3 2½	s. d. 3 3	s. d. 3 3½	s. d. 3 4	s. d. 3 4½	s. d. 3 5	s. d. 3 5½	s. d. 3 6	s. d. 3 6½	s. d. 3 7	s. d. 3 7½	s. d. 3 8	s. d. 3 8½	s. d. 3 9	s. d. 3 9½	s. d. 3 10	s. d. 3 10½	s. d. 3 11	s. d. 3 11½	s. d. 4	s. d. 4 ½	s. d. 4 1	s. d. 4 1½

American dollars	1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90	100
English £ s. d.	£0 4 2	£0 8 4	£0 12 6	£0 16 8	£1	£1 5 0	£1 9 2	£1 13 4	£1 17 6	£2 1 8	£4 3 4	£6 5 0	£8 6 8	£10 8 4	£12 10 0	£14 11 8	£16 13 4	£18 15 0	£20 16 8

EXAMPLE.—If you want to convert $94.62, table shows that $90 equals £18 15s.; $4 equals 16s. 8d.; 62 cents equals 2s. 7d.; total, £19 14s. 3d.

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PETERS' MODERN AMERICAN METHODS OF COPPER SMELTING, $4.
STETEFELDT'S LIXIVIATION OF SILVER ORES, $5.
HOWE'S METALLURGY OF STEEL (in preparation).

ABEL'S ACCIDENTS IN COAL MINES AND MINING LAWS OF THE UNITED STATES, GREAT BRITAIN AND GERMANY (in press), $4.
MEXICAN MINING CODE, $1.
VIVIAN'S COPPER SMELTING. ITS HISTORY AND PROCESSES. (SCARCE), $1.50.

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APRIL 6, 1889.

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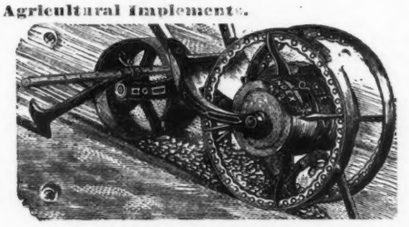
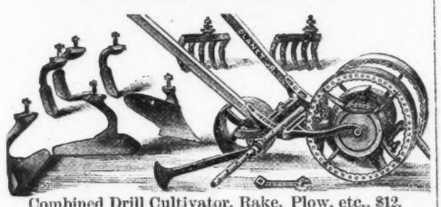
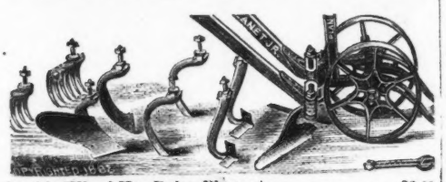
Agricultural Implements.



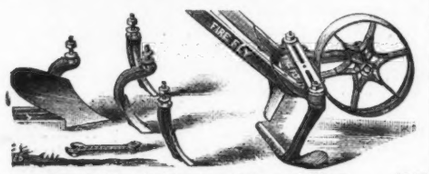
"Planet, Jr." No. 2 Seed Drill, $9.



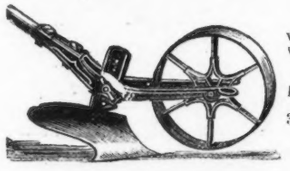
Combined Drill Cultivator, Rake, Plow, etc., $12.



Double-Wheel Hoe Rake, Plow, etc..... $8.00
Double-Wheel Hoe, plain (Hoe's only)..... 4.50



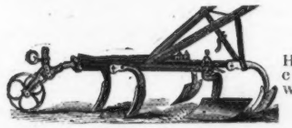
Single Wheel Hoe Cultivator, Rake and Plow..... $6.00



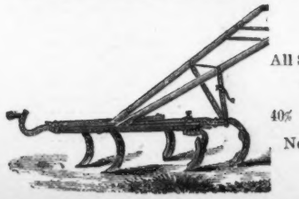
"Fire Fly" single-wheel Hoe, Cultivator and Plow, $5.

"Fire Fly" Hand Plow, $2.50.

30 % discount, f.o.b. New York.



All Steel Horse Hoe and Cultivator combined, with wheel, $11.



All Steel Plain Cultivator, $6.00.

40% discount, f.o.b., New York.

HAY FORKS.

Ely Hoe & Fork Co.—Gold Finish, Patent Overcaps.

Three Tine Forks.

No.	Tine.	Handles.		Per doz.
30	10 in.	4½ ft.	Boy's	$7.75
32	12 "	4 to 6 ft.		9.00
32 S	12 "	"	Strapped	10.50
32 B	12 "	"	Bent	9.50
32 B S	12 "	"	Bent & St'pd	11.00
33	12 "	"		9.50
33 S	13 "	"	Strapped	11.00
33 B	13 "	"	Bent	10 00
33 B S	13 "	"	Bent & St'pd	11.50
34	14 "	"		10.25
34 B	14 "	"	Bent	10.75
35	15 "	"		11.25
35 B	15 "	"	Bent	11.75
42 B	12 "	"	Bent	12.50
42 B S	12 "	"	Bent & St'pd	14.00

Manure Forks, Solid Steel Shanks, Gold Bronze Finish, Patent Overcaps.

No. 44, oval, 4 tine, 12 in. tine, 4 ft. handle, plain ferrules, $12.50 per doz.

No. 44 S, oval, 4 tine, 12 in. tine, 4 ft. handle, strapped ferrules, $14.

No. 44½, oval, 4 tine, 12 in. tine, 4½ ft. handle, plain ferrules, $12.50.

No. 44½ S, oval, 4 tine, 12 ft. tine, 4½ ft. handle, strapped ferrules, $14.

No. 54, oval, 5 tine, 13 in. tine, 4 ft. handle, plain ferrules, $19.50.

No. 54 S, oval, 5 tine, 13 in. tine, 4 ft. handle, strapped ferrules, $21.

No 64, oval, 6 tine, 13 in. tine, 4 ft. handle, plain ferrules, $22.50.

No. 64 S, oval, 6 tine 13 in. tine, 4 ft. handle, strapped ferrules, $24.

HOES.

Ely Standard Socket, all Gold Bronze Neck, full Pol'd, C. S. Blade.

Field, 7	× 5	in.,	selected handles	$9.00
" 7½	× 4½	"	" "	9.00
" 8	× 4½	"	" "	9.00
" 8½	× 4½	"	" "	9.00
" 8	× 5	"	" "	9.00

Washington County Pattern, spring handles..... 10.00
Rhode Island, 7 to 9 in., spr'g handles 9.00
" " 9½ in. " " 9.25
" " 10 " " " 9.50

Meadow, 9 × 4 in., poplar handles..... 9.00
Meadow, 9½ × 3½ in., poplar handles..... 9.25
Meadow, 10 × 3½ in., poplar handles..... 9.50
Broom Corn, 7½ × 4½ in., poplar handles..... 9.00

Popular Handles in Meadow Socket Hoes, unless otherwise ordered.

PLOWS.

Reversible Onconta Clipper.

16. Onconta Clipper, Reversible, Iron beam Cutter..... $14
" Onconta Clipper, Reversible, Iron Wheel and Cutter..... 15
18. Onconta Clipper, Reversible, Iron Beam Cutter..... 15
" Onconta Clipper, Reversible, Iron Beam, Wheel and Cutter..... 18
17. Hard Metal, Reversible, Iron Beam Cutter..... 17

17. Hard Metal, Reversible, Iron Beam, Wheel and Jointer..... 17
19. Hard Metal, Reversible, Wood Beam Cutter..... 16
" " " " " " Wheel and Jointer..... 17
20. Steel Mould Board, Reversible, Wood Beam Cutter 15
" " " " " " Wheel and Cutter..... 16

Iron Beam Plows.

Two-horse Sod and Stony Land..... 8.50 plain.
Curtis's Sod Two horse..... 11.50 "
" " " " ..... 13.00 cutter.
" " " " ..... 14.25 wheel & cutter.

Subsoil Plows.

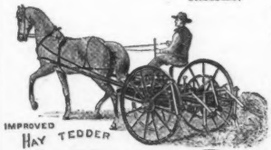
Two-horse 9.50 Draft Rod.
" " 11.00 Wheel and Draft Rod.

Hitchcock's Potato Digger and Shovel Plow.

Improved adjustable handle shovel plow..... 7.00
Hitchcock's Potato Digger..... 8.00
" " " and shovel plow..... 10.50

Dis. 30%.

RAKES.



The S. R. Nye Improved.

22 Teeth Rake, $32.00
26 " " 34.00

25% dis.

Chieftain Lock Lever
No. 1..... $30.00
No. 2..... 30.00
No. 5..... 29.00
Iron wheels, $2 extra.
With Pole, Double Tree and Neck Yoke, $2 extra.
22 cubic feet packed, 400 lbs. gro., 225 lbs. net.

Golden Farmer Self-Dumping Rake, $37.00; 22 cu. ft., 430 lbs. gro., 250 lbs. net.
Chieftain Hay Tedders, $59.00; 700 lbs. gro., 450 lbs. net.
Potato Diggers, $7.00; 100 lbs. gro., 60 lbs. net; dis., 40% f.o.b. ship New York or Boston.

RAKES (GARDEN).

Braced steel garden rakes. Per doz

8 teeth	$8.00
10 "	9.00
12 "	10.00
14 "	11.00
16 "	12.00

Braced malleable garden rakes.

10 teeth	$5.50
12 "	6.00
14 "	6.50
16 "	7.00

Smith-Harper Riveted Garden Rakes, Wood Heads.

No.	Wrought teeth.	Per doz.
8-teeth rakes, wrought, 6 feet handles		$5.00
10	" " "	5.50
12	" " "	6.25
14	" " "	7.00

Best Polished Cast Steel Rakes.

No.	Handles.	Per doz.	No.	Handles.	Per doz.
1—16	teeth, 6 feet	$12.00	4—10	teeth, 6 feet	$9.00
2—14	" 6 "	11.00	5—8	" 6 "	8.00
3—12	" 6 "	10.00	6—6	" 5½ "	6.00

Lawn or gravel rakes, price same cast steel garden rakes
Tar rakes, 14 teeth, 18 inch, iron shank, 4½ feet handles, net..... $12.00

Malleable Iron Garden Rakes.

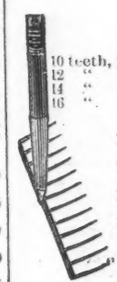
No.			Per doz.
8—8	teeth, polished, 5½ ft. handles		$5.00
10—10	" " 6	"	5.50
12—12	" " 6	"	6.00
14—14	" " 6	"	6.50
16—16	" " 6	"	7.00

10 doz. case lots, 60, 10 and 5% cased.

Geneva Tool Co.

Ten-Teeth Malleable Garden.	Plain.	Braced.	Steel Garden. Plain.	Braced.
10-Teeth	$5.50	$6.00	$9.00	$10.50
12 "	6.00	6.50	10.00	11.50
14 "	6.50	7.00	11.00	12.50
16 "	7.00	7.50	12.00	13.50

Dis. 70 and 5%.



Cast steel garden rakes.

	Per doz.
10 teeth, polished, tapering bar, tempered rake	$9.00
12 " " " " " " "	10.00
14 " " " " " " "	11.00
16 " " " " " " "	12.00

Cast steel lawn rakes.

12 teeth, polished, tapering bar, tempered rake	$10.00
14 teeth polished tapering bar, tempered rake	11.00
16 teeth polished tapering bar, tempered rake	12.00
18 teeth polished tapering bar, tempered rake	13.00

Dis. 70% from Standard Association list.
Prices made where XX handles, etc., are required.

SCYTHES (GRASS).

Waldron's pattern, oiled	$8.50
Silver steel, painted	8.50
Western dutchman, bronzed and painted	9.00
Clipper, polished web	9.00
Fine cutlery steel, full polished	10.00
All steel, full polished	11.00
Grain Scythes.	
Waldron's pattern, oiled	11.25
Silver steel, painted	11.25
Clover, oiled	11.25
Clipper, bronzed and painted	11.50
Lawn Scythes.	
Clipper, bronzed and painted	9.00

Dis., 40 and 10%.

SOWER, BROADCAST SEED.

Per dozen..... $36 f.o.b.

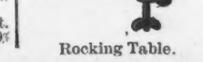
Gross wt., 110 pounds per dozen

Net wt., 75 pounds per dozen.

Apple Parers.

Little Gem.

	Per doz.
Advance	$4.75
Baldwin	5.25
Champion	7.25
Hudson's '88	3.75
Improved Bay State	30.
Monarch	31.50
Oriole	4.00
Turntable	4.50
Victor	13.50
White Mountain	4.50
Rocking Table	4.25
Little Gem Corer and Slicer	3.75



Rocking Table.

Anvils.

"Eagle anvils."

	Weight about			Weight about	
No. 000	½ lb	$1 00	No. 4	40 lbs	$4.25
" 00	4 "	1.70	" 5	50 "	5.05
" 0	10 "	2.20	" 6	60 "	5.50
" 1	15 "	2.75	" 7	70 "	6.00
" 2	20 "	3.00	" 8	80 "	7.00
" 3	30 "	3.75	" 9	90 "	8.00

Anvils weighing 100 to 800 lbs., 10 cts. per lb. Discount 20 and 10 %.

Arms and Ammunition.

Wood Powder.
American Wood Powder Company.
¼ kegs.

	Kegs, 25 lbs.	6¼ lbs.	1 lb. cans.
Trap for first quality arms only	$19.50	5.00	.85
A, for large bore C, for general use D, fine for small bore and rifles E, very fine for small bore rifles and gallery shooting	17.00	4.35	.75

Hartley & Graham,
Union Metallic Cartridge.

	Discount. Per cent.
Bullet Breech Caps, per lb.	1.60 10
Conical Bullet Caps "	1.75 10
Rim Fire Cartridges	60 10
Military Rim Fire Cartridges	15 10
Central Fire Pistol and Rifle Cartridges	40 10
Central Fire Metallic Cartridges for Target and Sporting Rifles	30 10
Military Cartridges, Central Fire	30 10
Lefaucheux Cartridges	60
Gatling Cartridges	Special
Primed Shells and Bullets	25 10
Friction Cannon Primers	20 10
Primers	10
Percussion Caps, F. C. per M.	33c.
U. M. C. "	42½c.
Musket "	45c.
Brass Shot Shells, U. M. C., 1st qual	60 10
Club brand	65 10

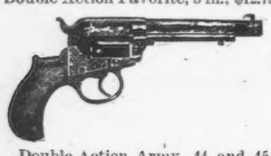
Paper Shot Shells.

14, 16 and 20 ga. First quality, 30, 10 and 10 per cent; 4, 8, 10 and 12 ga., First quality, 25, 10 and 10 per cent.
14, 16 and 20 ga. Club brand, 30, 10 and 10 per cent.
10 and 12 ga. Club brand, 33⅓, 10 and 10 per cent.
Gun Wads, 20 and 5 per cent.

REVOLVERS.

Smith & Weston

32, Single Action, 3, 3½ in., $8.00.
32, Double Action, 3, 3½ in., $9.35.
32, Safety Hammerless, 3, 3½ in., $11.00.
38, Single Action, 3¼ in., $9.40; 38, Single Action, 4 in., $9.65; 38, Single Action, 5 in., $10.00; 38, Double Action, 3¼ in., $10.40; 38, Double Action, 4 in., $10.65; 38, Double Action, 5 in., $11.00; 38, Safety Hammerless, 3¼ in., $12.00; 38, Safety Hammerless, 4 in., $12.25; 38, Safety Hammerless, 5 in., $12.50; 44, Single Action, 4 in., $11.50; 44, Single Action, 5 in., $11.75; 44, Single Action, 6, 6½ in., $12.00; 44, Double Action, 4 in., $12.50; 44, Double Action, 5 in., $12.75; 44, Double Action, 6½ in., $13.00; 44, Double Action Favorite, 5 in., $12.75.



Colts.

Discount, 10 per cent from following prices.

Double Action Army, 44 and 45 calibre, 4¾, 5½, 7½ inch bbl., $13.00.
Double Action, 41 calibre, 2½ to 6 inch bbl., $11.20.
" " 38 " 2½ to 6 " " $10.00.
Single " Army, 45 calibre, 4¾, 5½, and 7½ inch bbl., $12.00.
Single Action Army, 44 calibre, "Frontier," 4¾, 5½, and 7½ inch bbl., $12.00.
New Line, 41 calibre, blued or nickeled, $4.00.
" " 32 " " " 4.00.
" " 30 " " " 2.00.
" " 22 " half or full plate, 2.10.
Old Model, 22 calibre, by the hundred, half or full plate, $1.50.
Colt Deringer, 41 calibre, per pai half or full plate, $5.50.

American Bull Dog

Double Action 32, 38 and 44 calibre, 2½ inch barrel, $1.60; Double Action 32, 38 and 44 calibre, 4½ inch barrel, $1.85; Double Action 32, 38 and 44 calibre, 6 inch barrel, $2.10.

F. & W. British Bull Dog revolvers, 32 and 38 calibre 2½ inch bbl., $1.80.
F. & W. Automatic revolver, 32 and 38 calibre, 3¼ inch bbl., $5.50.
H. & R. Automatic revolver, 32 and 38 calibre, 3¼ inch bbl., $4.75.
Defender revolvers, Single Action, 22, wood handle, 65.
" " " " 22, rubber " 70.
" " " " 32, wood " 85.
" " " " 32, rubber " 90.

Remington Army revolver, Single Action, 44 cal., frontier cartridge, 5¾ inch barrel, $5.50.
Remington Army revolver, Single Action, 44 cal., frontier cartridge, 7½ inch barrel, $6.00.
Remington Double Deringers, 41 cal., rim fire, $4.05.
National Deringers, 41 calibre, per pair, half or ful plate, $4.00.
New House, 41 or 38 calibre, blued or nickeled, $5.00.
" Police, 38 calibre, 6 in., " " 7.00.
" " 38 " 4½ in., " " 7.00.

RIFLES.

Colts' Lightning Magazine.

	Discount 10 per cent.
40/60 and 45/60 calibre octagon barrel	10 lbs. $15.38
" " " " round "	9¾ " 14.25
" " " " carbine "	9 " 14.25
32, 38, and 44 calibres, octagon "	7¼ " 13.50
" " " " round "	6¾ " 12.38
" " " " carbine "	6¼ " 12.38
" " " " baby carbine	5¼ " 12.38
22 calibre, rim fire, octagon barrel	15.38
" " " round	14.25

Remington Light (Baby) carbines, 44 cal., nick., $7.50.

Assay Furnace.

Hydro-Carbon Blow-Pipe Assay Furnace.

No. 2, Muffle Furnace taking C Battersea Muffle 8x4¾x3 in. $10.00
No. 3, taking F Muffle, 10x6x4 in. 15.00
No. 1, Crucible Furnace, taking Battersea, U or Colorado B Crucible, 4 in. dia. 5½ deep. 4.00
No. 2, taking Battersea E, round, 5 in. dia., 6½ deep. 5.00
Blow-Pipe No. 1, with half gallon tank, made of plain, strong sheet metal. 18.00
Blow-Pipe No. 2, with half gallon tank, made entirely of seamless brass. 23.00
Blow-Pipe No. 3, with one gallon tank, otherwise same as No. 2. 26.00
Blow-Pipe No. 1, Muffle Furnace No. 2, and Crucible Furnace No. 1. 32.00
Blow-Pipe No. 2, Muffle Furnace No. 2, and Crucible Furnace No. 1. 37.00

Axes, etc.

Shingling Hatchets.

	1.	2.	3.	
Collins'	$4.75,	$5.25,	$5.75	doz., dis. 10%.
Peck's	$8.00,	$8.50,	$9.00	doz. dis. 45%.
Ryder's	$8.00,	$8.50,	$9.00	doz., dis. 50%.

Claw Hatchets.

	1.	2.	3.	
Collins'	$5.25,	$5.75,	$6.25	doz., dis. 10%.
Peck's	$9.00,	$9.50	$10.00,	doz., dis. 45%.
Ryder's	$9.00,	$9.50,	$10.00	doz., dis. 10%

Hatchets, Broad Single Bevel.

Collins', cut in., 5, $9.50; 5½, $10.00; 6, $10.50; 6½, $11.00; 7½, $11.50; dis. 10%.

Peck's, cut in., 4, $10.50; 4½, $11.50; 5, $13.00; 5½, $14.50; 6, $16.50; 6½, $18.00; 7½, $19.50; 8¼, $22.00; dis. 45%.

Ryder's, cut in., 5, $13.00; 5½, $14.50; 6, $16.50; 6½, $18.00; 7½, $19.50; dis. 50%.

Adzes.

	House. Half flat head. Dozen.	Ship spur poll. Dozen.	Discount. Per cent.
Collins'	$14.00	$13.00	10
Peck's	24.00	25.00	45
Ryder's	24.00	25.00	50

Broad Axes—Pittsburgh Pattern.

5 to 8 pounds, $32.00 dozen.
7 to 9 pounds, $35.00 dozen.
8 to 10 pounds, $38.00 dozen.
9 to 12 pounds, $45.00 dozen.
Western pattern same price.

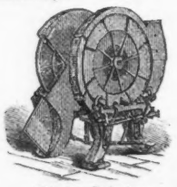
Spanish Pattern. Detumba round eye. $10.50 per doz.

Spanish Pattern Media labor, $12.25 per dozen.

Axle Grease.

Frazer's (2-lb. tins), per gross	$18.00
2-lb. wooden boxes, "	12.00
Discount, 25 and 5 %.	
Dixon's Everlasting, boxes 1 lb., per doz	$1.20
" " " 2 lbs., "	2.00

Barrel Machinery.



Stave Jointers.

Single Wheel Beer Keg Stave Jointer,	16 to 22 in.	8	8	$190
Double " " " "	16 " 22 "	8	8	330
Single Wheel Half Barrel "	24 " 30 "	8	8	275
Double " " " "	24 " 30 "	8	8	440
Single " Barrel "	30 " 36 "	8	8	330
Double " " " "	30 " 36 "	8	8	501
Double Indepdent Barrel Stave Jointer with Wheels, on separate shafts, but suspended in one frame, 30 to 36 in		8	8	520
Single Wheel Barrel Stave Jointer,	32 to 38 in.	8	8	350
Double " " " "	32 to 38 "	8	8	550
Double Independent Barrel Stave Jointer,	32 to 38 in.	8	8	575

Bellows.

Miner's Bellows: 24 in., $8.50; 26 in., $9.75; 28 in., $11.00; 30 in., $11.25; 32 in., $13.50.
60 and 5% dis.
Standard, each: 18 to 24 in., $10; 28 in., $12; 32 in., $14; 34 in. $16; 36 in., $18; 38 in., $20; 40 in., $23; 44 in., $32.
60 and 5% dis.
Hand Bellows, per doz.: 6 in., plain, $10; fancy, $20; 7 in., plain, $12; fancy, $24; 8 in., plain, $14; fancy, $28; 9 in., plain, $16; fancy, $32; 10 in., plain, $18; fancy, $36.
50% dis.

Belting and Packing.

LEATHER BELTS.

Newark Leather Belting.
Single belts per foot.

Width.		Width.		Width.	
1 inch	.10	6 inch	.76	20 inch	2.84
1¼ "	.13	7 "	.90	21 "	3.02
1½ "	.17	8 "	1.02	22 "	3.20
1¾ "	.20	9 "	1.15	23 "	3.37
2 "	.23	10 "	1.29	24 "	3.54
2¼ "	.26	11 "	1.42	26 "	3.92
2½ "	.30	12 "	1.55	28 "	4.30
2¾ "	.33	13 "	1.68	30 "	4.64
3 "	.36	14 "	1.82	32 "	5.00
3½ "	.43	15 "	1.98	34 "	5.35
4 "	.50	16 "	2.14	36 "	5.70
4½ "	.56	17 "	2.31	40 "	6.40
5 "	.63	18 "	2.49	44 "	7.10
5½ "	.70	19 "	2.66	48 "	7.80

Double belts twice the price of single.
Dis. single and double belts, cemented, 50 and 5%.
Dis. single and double belts, riveted and cemented, and 5%.
Dis. single belts, cemented and lacesewn, water proofed, 50%.
Dis. double belts, cemented and lacesewn, water proofed, 45%.

LINK BELTING.

Link-Belt Machinery Co.'s. Price per running foot, net.

No.	Price.	No	Price.
25	$0.13	78	$0.40
32	.13	83	.45
33	.12	85	.50
34	.13	88	.50
35	.14	95	.60
42	.16	103	.75
45	.16	105	.70
51	.20	106	.90
52	.25	107	.80
55	.22	108	.80
57	.24	109	.90
62	.30	114	1.10
66	.30	122	1.50
67	.30	124	1.30
75	.35	146	1.40
77	.35		

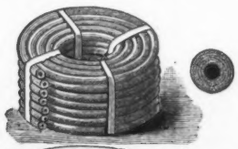
Sprocket wheels. 25%

RUBBER BELTING.

Inches.	2 ply per foot.	3 ply per foot.	4 ply per foot.	5 ply per foot.	6 ply per foot.
1	$0.07	.....	.....	.....	.....
1¼	0.09	.....	.....	.....	.....
1½	0.11	.....	.....	.....	.....
2	0.15	$0.17	$0.21	.....	.....
2½	0.18	0.22	0.26	.....	.....
3	0.22	0.26	0.31	.....	.....
3½	0.26	0.30	0.37	.....	.....
4	0.30	0.34	0.42	.....	.....
4½	0.33	0.39	0.47	.....	.....
5	0.36	0.43	0.52	.....	.....
6	0.43	0.52	0.62	.....	.....
7	0.51	0.60	0.73	.....	.....
8	0.59	0.70	0.84	$1.05	$1.25
9	0.67	0.80	0.95	1.18	1.42
10	0.75	0.90	1.07	1.33	1.60
11	0.83	1.00	1.18	1.47	1.77
12	0.91	1.08	1.30	1.62	1.95
13	1.00	1.18	1.42	1.77	2.13
14	1.08	1.28	1.54	1.92	2.31
15	1.16	1.38	1.66	2.07	2.49
16	1.25	1.50	1.78	2.22	2.67
18	1.41	1.70	2.02	2.52	3.03
20	1.58	1.90	2.26	2.82	3.39
22	1.76	2.12	2.52	3.15	3.74
24	1.96	2.36	2.80	3.50	4.20
26	2.18	2.60	3.08	3.85	4.62
28	2.42	2.84	3.36	4.20	5.04
30	.....	.....	3.64	4.55	5.46
32	.....	.....	3.92	4.90	5.88
34	.....	.....	4.20	5.25	6.30
36	.....	.....	4.48	5.60	6.72
38	.....	.....	4.76	5.95	7.14
40	.....	.....	5.04	6.30	7.56
42	.....	.....	5.32	6.65	7.98
44	.....	.....	5.60	7.00	8.40
46	.....	.....	5.88	7.35	8.82
48	.....	.....	6.16	7.70	9.24
50	.....	.....	6.44	8.05	9.66
52	.....	.....	6.72	8.40	10.08

Dis. High Grade, 60 and 5. Dis. Royal, 60, 10 and 10.
Dis. Manhattan, 70 and 5.

PACKING.

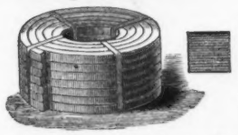


Piston Packing.

Round Piston Packing. Per lb. 85c. Discount, 60, 10 and 5 per cent.

Square Piston Packing.

Price same as above. Round and square piston packing is made in lengths of twelve or twenty-four feet.



Square Piston Packing. Rubber back, per pound $1. Discount 60 per cent. Best only.

Square piston packing, rubber back is made in engths of twenty feet.

Steam Packing.
Cloth Insertion, Rubber Outside.
Cloth Insertion, Cloth on one or both sides.

Thickness.	1-Ply.	2-Ply.	3-Ply.	4-Ply.
1-64 inch	70 cts.	.....	.....	.....
1-32 "	65 cts.	.....	.....	.....
1-16 "	60 cts.	63 cts.	66 cts.	.....
3-32 "	55 cts.	58 cts.	61 cts.	.....
1-8 "	55 cts.	55 cts.	58 cts.	61 cts.
3-16 "	55 cts.	55 cts.	55 cts.	58 cts.
1-4 "	55 cts.	55 cts.	55 cts.	55 cts.

One-ply of cloth to every 1-16 inch thickness.
Three cents per pound additional will be charged for each extra ply of cloth. Each cloth, whether insertion or on outside, to count as one ply.
All cloth insertion or plain packing is one yard wide, and any length desired.
Wire insertion packing, all thicknesses, per lb, 50 cents.
Discounts: B 2, 70 & 10; A, 60, 10 & 10; AA, 60 per cent.

GASKETS.

Corrugated Copper.

Price, 2 cents per square inch, less 30 per cent. discount for home trade.

Less 60% discount for export trade.

Bolts.

Philadelphia Tire Bolt, with forged nuts.
Price per hundred.
Condensed list.

Length	1-8	3-16	7-32	1-4	5-16	3-8
1	$1·50	$1.50	$1.50	.....	.....	.....
2	1·50	1.60	1.85	$2.25	$3.05	$5.00
3	.....	1.90	2.25	2.75	3.65	5.80
4	.....	.....	.....	3.25	4.25	6.60
5	.....	.....	.....	.....	4.90	7.40

Fractional sizes, intermediate prices.
Discount 80 and 25 %.

Common Carriage Bolts, price per hundred.

Length.	3-16 & 1-4	5-16	3-8	7-16	1-2	9-16 & 5-8	3-4
1 to 1½	$1.35	$1.60	$2.30	$3.10	$3.80	$7.50	
2	1.45	1.75	2.30	3.10	3.80	7.50	
3	1.65	2.05	2.70	3.60	4.44	7.50	$13.50
4	1.85	2.35	3.10	4.10	5.08	8.50	14.90
5	2.05	2.65	3.50	4.60	5.72	9.50	16.30
6	2.25	2.95	3.90	5.10	6.36	10.50	17.70
7	2.45	3.25	4.30	5.60	7.00	11.50	19.10
8	2.65	3.55	4.70	6.10	7.64	12.50	20.50
9	2.85	3.85	5.10	6.60	8.28	13.50	21.90
10	3.05	4.15	5.50	7.10	8.92	14.50	23.30
12	3.45	4.75	6.30	8.10	10.20	16.50	26.10
14	3.85	5.35	7.10	9.10	11.48	18.50	28.90
16	4.25	5.95	7.90	10.10	12.76	20.50	31.70

Fractional sizes, intermediate prices.
Discount 75 and 10%.

Philadelphia Carriage Bolt, price per hundred.

Length	1-8, 3-16 & 1-4	5-16	3-8	7-16	1-2
1 inch.	$3.00	$4.00	$5.00	$7.40	$9.00
2 "	3.40	4.10	5.00	7.40	9.00
3 "	3.80	4.70	5.80	8.20	10.00
4 "	4.20	5.30	6.60	9.00	11.00
5 "	4.80	6.00	7.40	9.80	12.00
6 "	5.40	6.60	8.20	10.60	13.00
7 "	.....	7.30	9.00	11.40	14.00
8 "	.....	7.90	9.80	12.20	15.00
9 "	.....	8.50	10.60	13.00	16.00
10 "	.....	.....	11.40	13.80	17.00
11 "	.....	.....	.....	14.60	18.00

Fractional sizes, intermediate prices.
Discount 80 and 5 %.

Can Openers.

	Gross.		Doz.	
American	$3.00	Eureka	$2.50	10 % dis.
Duplex	2.70	20 % dis.	Domestic	2.50	45 % dis.

Carpet Sweepers.

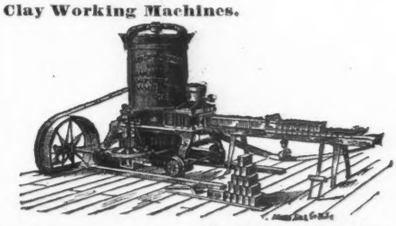
	Per doz.
Bissell's, No. 5	$17.00
" New drop pan, No. 7	19.00
" Grand	36.00
" Superior	
Grand Rapids	24.00
Magic	15.00

Cigarettes (all tobacco).

Liberty Bell (small cigars)	$6.00 per 1000
Golden Giants (regular shape)	7.00 " "

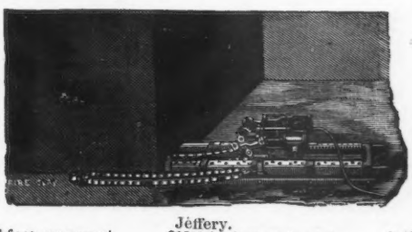
Net f. o. b., New York.

Clay Working Machines.



	No. brick per day.	Compl'te.
No. 10 D brick machine	50,000	$1,500
No. 10 S " "	30,000	1,200
No. 4 " "	40,000	1,100
No. 7 S " "	20,000	650
No. 6 S " "	15,000	575
No. 2 E. H. P. "	6,000	3,360

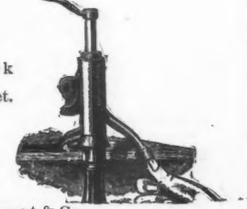
Coal Mining Machine.



Jeffery.

6 feet undercut.....$1500 | 5 feet undercut.....$1400
Jeffery Power Coal Drills.
Air feed drill.....$275 | Screw feed drill.....$200
Discount, 10%.

Cork Pullers.



The Samson Cork Puller, per dozen, $12 net.

Crucibles.

E. H. Sargent & Co.
Battersea Crucibles, Triangular.

No.	Height. Inches.	Width. Inches.	Crucibles. Per doz.	Covers. Per doz.
S	4½	4⅛	$1.00	$0.50
T	4	3¾	0.80	0.50
U	3½	3¼	0.60	0.40
V	3¼	2⅞	0.45	0.40
W	2⅞	2⅝	0.35	0.30
X	2½	2¼	0.30	0.30
Y	1⅞	2⅛	0.25	0.30
Z	1¾	1¾	0.20	0.30

Battersea Muffles, any size, made to order.
See Illustration in advertisement.

No.	Long. Inches.	Wide. Inches.	High. Inches.	Price. Each.
A	7	3½	2½	$ .60
B	7½	4⅜	2⅞	.75
C	8	4¾	3	.85
D	8½	5	3¼	1.00
E	9	5½	3⅝	1.15
F	10	6	4	1.25
G	11	4	3½	1.00
H	10½	5¼	3⅞	1.00
J	12	6	4	1.25
K	14	8	5	1.75
L	15	9	6	2.00

Export discount, 15 %.

Cutters.

FEED.

No. of cutter.	No. of knives.	Length in inches of knives.	Length in inches of feed cut.	Price.
1	2	6¼	½, ¾ and 1⅛	$18.00
2	2	7¼	½, ¾ and 1⅛	21.00
2½	1	7¼	⅝, ⅞, 1¼ and 1¾	21.00
2½	2	7¼	⅜, ½, ⅝ and ⅞	23.00
3	1	8½	⅝, ⅞, 1¼ and 1¾	25.00
3	2	8½	⅜, ½, ⅝ and ⅞	27.00
4	1	10	⅝, ⅞, 1¼ and 1¾	30.00
4	2	10	⅜, ½, ⅝ and ⅞	33.00
5	2	10	⅜, ½, ⅝ and 1¼	35.00
6	2	11	⅜, ¾, 1¼ and 2	45.00
6½	2	11	⅜, ¾, 1¼ and 2	45.00
7	2	13	⅜, ¾, 1¼ and 2	60.00
7½	2	13	⅜, ¾, 1¼ and 2	60.00
10	2	16	⅜, ¾, 1¼ and 2	80.00
12	2	20	⅜, ¾, 1¼ and 2	100.00
11	2	11	⅜, ¾, 1¼ and 2	45.00
13	2	13	⅜, ¾, 1¼ and 2	60.00
16	2	16	⅜, ¾, 1¼ and 2	80.00
20	2	20	⅜, ¾, 1¼ and 2	100.00

The knife arbors for all sizes are made of machinery steel. 30 per cent. dis.

VEGETABLE—GALE'S.

Size.	Weight of Fly Wheel. Pounds.	Will cut per hour. Pounds.	Price
No. 1½	20	1,500	$12
No. 2½	32	1,700	15
No. 3½	32	1,700	15
No. 4	42	2,000	18
No. 5	50	3,000	25
No. 10	65	8,000	35

30% dis.

Duck and Twine.

Baltimore T. & N. Co.—22-inch, Hard, Medium and Soft.

	Weight per yd.	Cents, per yd.		Weight per yd.	Cents, per yd.
No. 0	19 oz.	35	No. 6	13 oz.	26
1	18 "	33	7	12 "	25
2	17 "	32	8	11 "	23
3	16 "	30	9	10 "	21
4	15 "	28	10	9 "	20
5	14 "	27			

Ravens, 28½-inch.

	Cents, per yd.		Cents, per yd.
Eight ounce	15	Twelve ounce	22
Ten "	19	Fifteen "	27

Dis. 25 and 15.
Cotton Sail Twine.
Three-fold and upward, 17 to 20 cents per pound.
Dis. 3%.

Egg Beaters.

Dover	Per doz. $2.00	H. & R. Mfg. Co.	
Standard Co.		Double	Per gross, $16.20
Kingston	Per gross, $6.50	Triple	16.20
Acme	" 6.00	Easy	" 14.00
Rival	" 12.00	Spiral	" 4.50
Duplex	" 15.00	Paine, Diehl & Co., p.g.	24.00

Dis. — —.

Electroplate.—Babcock & Co.'s.

CASTERS.

1,200—Dinner.

232—Breakfast.

Dinner Casters.

No. 1,200. 17½ in. high, $8.00, quadruple plate.
No. 80. 17 in., $6.00, quadruple plate.
No. 140. 16 in., $7.50, " "
No. 830. 16 in., $5.00, " " Plain, 50 cents less.
No. 25. 16 in., $4.00, double plate.
No. 33. 16 in., $3.75, " "
No. 53. 15 in., $3.00, " "
No. 15½. 14½ in., $2.00, single plate.
No. 19. 14½ in., $1.85, " "
No. 40. 14 in., $1.75, " "

Breakfast Casters.

No. 231. 10 in. high, $4.00, quadruple plate.
No. 232. 12 in. high, $6.00, quadruple plate.
No. 13. 12 in. high, $2.25, double plate.
No. 12. 10½ in. high, $1.75, single plate.

No. 681.

CAKE BASKETS.

Quadruple Plate.

No. 448. 7 in. high-chased $16; gold lined, $17.
No. 690. 7½ in. high, chased, $7; gold lined, $8.
No. 686. 6½ in. high-chased, $4.50; gold lined, $5.50.
No. 681. 6 in. high, chased, $3; gold lined, $3.50.

BUTTER DISHES.

No. 126. 11 inches high, $5.50.
No. 127. 7 inches high, $5.50.
No. 75. 8 inches high, $1.85.
No. 78. 7½ inches high, $2.00.

Discount. 60 and 2½ per cent.

CHILD'S SETS.

No. 90.

No. 90. Satin-lined case, cup, saucer, knife, fork and spoon, $2.25.
No. 41. Cup, gold lined, in fancy case, $1.15.
No. 43. Cup and saucer, gold-lined, fancy case, $1.15.

FLAT WARE.

Calla Lily, Empress, Windsor and Olive Patterns, 18 Per Cent Nickel Silver Base.

	Extra plate, per doz.	Double plate, per doz.	Triple plate, per doz.
Tea spoons	$4.75	$6.00	$7.25
Dessert spoons	8.50	10.50	12.50
Table spoons	9.50	12.50	14.50
French coffee spoons	4.75	6.00	7.25
Berry or nut spoons	24.00	30.00	36.00
Bar spoons, small	4.75	6.00	7.25
Dessert forks	8.50	10.50	12.50
Medium forks	9.50	12.00	14.50
Oyster forks	7.00	9.00	11.00
Sugar shells	9.00	11.00	13.00
Sugar tongs	25.50	31.50	37.50
Butter knives, twist or reversed handles	10.50	12.50	14.50
Nut picks	4.75	6.00	7.25
Pie knives, engraved blades	42.00	51.00	60.00
Soup ladles	48.00	60.00	72.00

PICKLE DISHES.

No. 146.

No. 144. 12 in. high, $3.50.
No. 66. 10½ in. high, $2; assorted colored glass.
No. 155. 12 in. high, $1; assorted colored glass.
No. 146. 12½ in. high, $9; hand decorated glass.
No. 156. 12½ in. high, $6; hand decorated glass.

TEA SETS.

No. 255.

No. 255. 6 pieces, $35, quadruple plate.
No. 301. 4 pieces, $23, quadruple plate.
No. 1847. 6 pieces, $42, quadruple plate.

ICE PITCHERS.

No. 754.

No. 754. 21 in. high, double wall, $30, quadruple plate.
No. 640. 12½ in. high, double wall, $15, quadruple plate.
No. 751. 12½ in. high, single wall, $6, double plate.

Flue Cleaner.

Hurley's Automatic Steam Flue Cleaner.

No.	Outside diam. of tubes.	With hose clamps.	Globe Valves.	Best 4-ply steam hose. Per foot.
1	1½ to 2	$5.00	½, 95 cents	¾, 67 cents.
2	2 to 2½	6.25	½, 95 cents	¾, 67 cents.
3	2½ to 3	7.50	¾, $1.30	¾, 67 cents.
4	3 to 3½	8.75	1, 1.75	1¾, 83 cents.
5	3½ to 4½	10.00	1¼ 2.90	1¼, $1.04

Dis. on flue cleaners, 60 and 70%.
Dis. on steam hose, 50%, good to 90 lbs steam.

Flouring Mill Machinery.

Nordyke & Marmon Co.

Roller Mills for Wheat Flour.

Prices of Double and Single Roller Mills.

Size.	All smooth.	½ Corrug. ½ smooth.	All corrug.	Single machines. Corrug.	Smooth.
6×12	$465	$475	$480	.....	.....
6×16	515	525	530	.....	.....
6×20	565	575	580	.....	.....
7×14	515	525	530	.....	.....
7×18	560	570	575	.....	.....
7×24	635	645	650	.....	.....
9×18	625	640	650	$350	$335
9×24	700	720	735	390	375
9×30	785	810	830	440	420

20-inch New Era Mill for Wheat, Corn, and Middlings.

Size. Inch.	Power. H. P.	Pulley. Inch.	Capacity Bush.
20	4 to 10	14×7	12 to 40

Speed.	Weight. Lbs.	Price.
500 to 800	660	$150

The Nordyke Bradford Portable Mill.

Size of stones, In.	Grinding capacity. Corn, bu. per hour.	Wheat bu. per hour.	Horse-power.	Weights. Sing'l gear.	Double gear.	Pulley mill.	Geared mills. Iron wh'ls.	Mortise wh'ls.
18	8 to 10	.....	4	550	625	$130	$165	$180
20	10 to 12	.....	5	600	700	140	175	190
22	12 to 15	.....	5	700	850	160	190	210
24	15 to 18	.....	6	900	1050	175	210	225
26	18 to 20	8 to 10	8	1200	1400	185	225	250
30	20 to 25	10 to 12	10	1500	1700	225	265	290
36	25 to 30	14 to 17	12	1800	2100	315	355	380
42	35 to 40	19 to 21	15	2000	2300	390	435	460

Farm and Plantations' Mills.

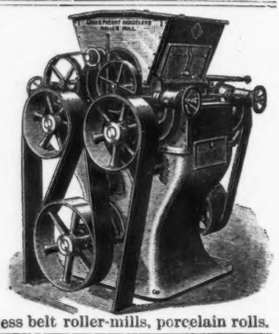
Diameter of burrs.	Power to drive.	Size of pulley.	Capacity per hour.	Revolutions per minute.	Weight.	Price.
	H. P.					
14 in.	2 to 4	9×5½	4 to 14 bushels	600 to 1200	370 lbs.	$100
18 in.	4 to 10	11×6½	8 to 40 bushels	400 to 700	600 lbs.	130

The Dixey Mill—Stiff Spindle Style.

Size.	Power.	Capacity.	Weight. Pulley.	Geared	Pulley.	Iron gear.	Mortise gear.
18	4 to 6 H.P.	8 to 25 bu	560 lbs	650	$130	$165	$180
22	6 to 8 "	12 to 30 "	800 "	1000	165	200	225
26	8 to 12 "	16 to 40 "	1100 "	1500	185	220	245
30	10 to 15 "	25 to 60 "	1300 "	1700	215	255	280

Flour Mills.

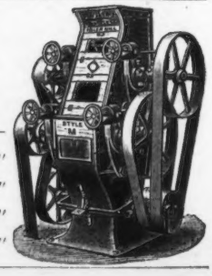
E. P. Allis & Co.



Gray's pat. noiseless belt roller-mills, porcelain rolls.

Size of Rolls.	Height.	Length.	Width.	Driving pulley.	Revolutions per minute.	Approximate power required.	Length of driving belt above floor.	Approximate shipping weight.	Price.
With corrugated chilled iron rolls.									
14" × 16" single	5' 7"	3' 2"	4' 5"	20" × 6½"	200 to 300	1¾ to 2½ H. P.	16' 3"	2,700 lbs.	$600.00
14" × 16" double	5' 10"	5' 6"	4' 10"	20" × 6½"	200 " 300	3 " 4 H. P.	19 3"	4,000 "	800.00
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 " 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	580.00
With Wegmann's patent porcelain rolls.									
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$600.00
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$650.00
Divided four roller machines.									
9" × 14"	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$500.00
1-pr. cor. 1-pr. sm.	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16 6"	2,700 lbs.	615.00
9" × 14" 1-pr. sm. 1-pr. por.	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	625.00
9" × 14" 1-pr. cor. 1-pr. por.	5' 1½"	3' 10"	3' 10"	12" × 5¼"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	

For grinding corn, feed, rye, etc.



Size.	Height.	Width.	Length.
6" × 12"	4' 6"	3' 5"	2' 7"
9" × 14"	5' 8"	3' 10"	3' 5"
9" × 18"	5' 8"	4' 9"	3' 5"
9" × 24"	5' 8"	5' 6"	3' 5"

Driving pulley.	Revolutions per minute.	Length of belt above floor.	Approximate shipping weight.	Price.
10″ × 5¼″	400 to 500	14′	.....	$500.00
14″ × 6¼″	350 to 450	18′	2600 lb.	600.00
14″ × 7¼″	350 to 450	18′	3050 lb.	650.00
14″ × 8¼″	350 to 450	18′	3350 lb.	735.00

Forges (Portable).

Fairbanks.

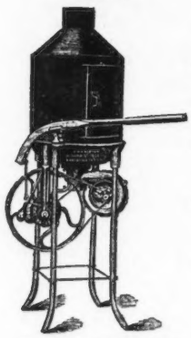
No. 2c, weight, 155 lbs. 21 × 27 hearth.....$42.00
" 3a, " 80 " 18 in. diam. hearth..... 27.00
" 3b, " 75 " 18 " " " 24.00
" 3c, " 85 " 18 " " " 30.00
" 6a, " 45 " 14 " " " 18.00
" 6B, " 45 " 14 " " " 16.00
Dis. 60%.

Bullock's (Portable.)

No. 1, 18 in. bellows, $20; No. 2, 20 in. bellows, 25; No. 3, 22 in. bellows, $30.
20% dis.
Stationary.
27 in. bellows, $21; 30 in. bellows, $25; 33 in. bellows, $33; 36 in. bellows, $45.
20% dis.

Riveting Forges.

Bellows, 18 in., 20 in., 22 in., 24 in., $8.00. $10.00. $13.00. $17.00.
20 % dis.



Empire.

Light work, 12 × 17; height, 15 in., $16.00.

Same, with Hood, 12 × 17; height, 28 in., $20.00.

Bridge, Boiler or Railroad work, Pan, 17 × 19; height, 29 in.; Fan, 8 in., $27.00.

Same, with Hood, $30.00.

Water Tank, $4.00 extra.

Iron Fire Ring Round Tuyere, $1.00 extra.

50 % dis., f.o.b. at Cohoes.

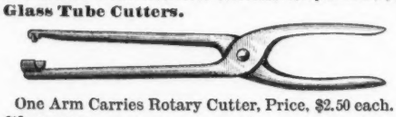
Fruit Evaporator.

No. 1. Evaporator..... $30
No. 2. Fruit Drier and Baker, with Bleacher attachment. Weight, 225 lbs. Capacity, 5 to 7 bushels apples per day; 24 in. deep, 26 in. wide, 5½ ft. high; 12 trays, 22 22; 40 square feet drying surface. Complete..... $50
No. 3. Capacity, 15 to 20 bushels per day..... 100
No. 4. Capacity, 20 to 30 bushels per day..... 16
Dis., No. 1, 3 and 4 = 20%.
" 2 = 30%
Boxing, extra:
No. 1, $3.00; No. 2, $5.00; No. 3, $7.50; No. 4, $12.50.
Freight to New York:
No. 1, $4.00; No. 2, $6.00; No. 3, $1.00; No. 4, $18.00.

Fruit Presses.

P., D. & Co. ....per doz., $1.50

Glass Tube Cutters.



One Arm Carries Rotary Cutter, Price, $2.50 each.

Glassware.

6-in. bowl and cover, per doz.....$3.25
7-in. " " " 4.50
8-in. " " " 6.00
9-in. " " " 8.00
10-in. " " " 10.50
Net.

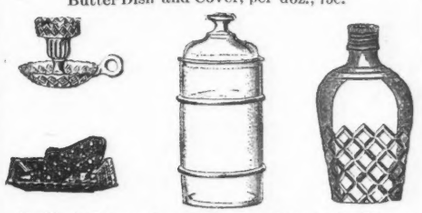
Nappy, 4½-inch., per doz., 50c.; 6-inch., per doz., $2; 7-inch., per doz., $3; 8-inch., per doz., $4.
Cream Pitcher, 1 pint, per doz., $1.25; one quart, per doz., $3.50; 3 pints, per doz., $4.50.
Pint Pitcher, per doz., $1.50; quart pitcher, per doz., $2; ½ gallon pitcher, per doz., $3; 3 quart pitcher, per doz., $4.50.

Flange Butter and Cover, per doz., $1.75.
Water Set, per doz., sets of 60 pieces, $7.50.

Cheese Dish and Cover, 8 in., per doz., $4.50.
Quart Water Bottle, per doz., $4.50.

Ind. Salts; per gross, $2.00. Assorted patterns.
4 Bottle Castors, per doz., $7.50; 3 bottle, per doz., $4.50.

Berry Dish, 4½-inch , per doz., 50c.; 10-inch, per doz., $4.
Butter Dish and Cover, per doz., $1.25.
Butter Dish and Cover, per doz., 75c.



Candlesticks, per doz., $2.00. Glass Slipper for Flowers, per doz., 50 cents; slipper and tray, per doz., $1. Jam Jar and Cover, 1 qt., per doz., $2.50; ½ gal., per doz., $3.25; ¾ gal., per doz., $4 ; 1 gal., per doz., $5 ; 1½ gals., $9 ; 2 gals., per doz., $12. Pocket Flask, 1 pint, $1.

Tumblers.
1⅞ oz., per doz., 50 cents.
8 " " 75

9 oz., per doz., $2.75.

11 oz., assorted patterns, per doz., 30 cts.

9½ oz., assorted patterns, per doz., 25 cts.

1 oz. to 12 oz., nested for shipping, per doz. nest, $2.

Goblets, banded, per doz., 65 cents.
Claret to match, per doz., 55 cents.
Wines, to match, per doz., 50 cents.
Cordials, to match, per 45 cents.

Banded, open, hollow stem.

Goblets, per doz., 50 cts.
Claret, " 50 "
Wine, " 35 "

Champagne, per doz., $1.25.

½ Pt. tumbler, per doz..55 cts.
½ Pt. mug to match, " ..65 "
Goblet, " " ..50 "
Spoon holder, cream pitcher, sugar, butter dish to match.
Sets of 4 pieces, per doz. sets, 48 pieces, $3.75.

Hammers.

H. Cheney Hammer Co.

Adz-eye Hammers.—Per Dozen.

No.	Weight.		No.	Weight.	
5.	Round.	1 lb., 4 oz.	$9.00	7½. Round.	13 oz. $8.00
7.	"	1 lb.	8.50	8 "	7 oz. 7.50

Adz-eye Hammers.—Per Dozen.

No.	Weight.		No.	Weight.	
17.	Octagon.	weight, 1 lb., 4 oz.	$9.00		

Adz-eye Hammers.—Patent Nail Holder.—Per Dozen.

No.	Weight.		No.	Weight.	
33.	Bell-face.	1 lb., 4 oz.	$9.50	35. Round h.	1 lb., 4 oz. $9.50
34.	"	1 lb.	9.00	36. "	1 lb. 9.00

Adz-eye Hammers.—Bell Face.—Per Dozen.

No.	Weight.		No.	Weight.	
37.	1 lb., 4 oz.	$9.00	38½.	13 oz.	$8.00
38.	1 lb.	8.50	39½.	7 oz	7.50

Farriers' Hammers.—Per Dozen.

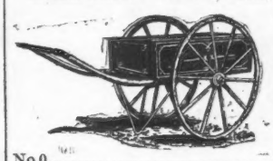
No.		Weight.	
55.	Adz-eye. Octagon.	9 oz.	$7.75
56.	"	7 oz.	7.50
57.	Plain. "	7 oz.	6 25
58.	Plain Brad.	4 oz.	5 50
60.	Adz-eye, Round Head.	7 oz.	7 50
61.	" Octagon. Boston pattern	10 oz.	8.00
62.	" "	7 oz.	7.50

Machinists' Ball Pein Hammers.—Octagon.—Per Dozen.

No.	Weight.		No.	Weight.	
90.	3 lbs.	$22.00	94.	1 lb., 4 oz.	$13.50
90½.	3 lbs., 8 oz.	19.00	95.	1 lb.	12.50
91.	4 lbs., 4 oz	17.50	96.	12 oz.	12.00
92.	2 lbs.	16.50	97.	8 oz.	12.00
92½.	1 lb., 12 oz.	15.50	98.	6 oz.	12.00
93.	1 lb., 8 oz	14.50			

Discount, 35 and 5 per cent. Net Cash, 30 days. 10 per cent. Cash, 10 days. Cases at Cost.

Hand Carts



No. 0, 42 wheel, 1 in. tread, 1 in. axle, box 48x28x10 deep $10.50.
No. 1, 36 wheel, 1 in. tread, ⅞ in. axle, box 40x23x10 deep, $9.00.
No. 2, 30 wheel, ¾ in tread, ¾ in. axle, box 32x20x9 deep, $8.25.
With Wagon-Seat Spring.
No. 6, same sizes as No 0.....$12.00
" 7, same sizes as No. 1..... 10.50
" 8, " " " No. 2..... 9.75
With Third Wheel, Without Springs.
No. 3, same sizes as No. 0.....$12.00
" 4, " " " No. 1..... 10.50
" 5, " " " No. 2..... 9.5

Handles.

	Doz.		Doz.
Extra, Axe 36-inch	$1.90		
No. 1	$1.50	No 2	1.10
Extra, Axe, Boys, 26 and 28 inch	1.25		
No. 1	$1.15	No. 2	85
Extra, Axe, Broad or Squaring	2.00		
No. 1	$1.50	No. 2	1.25
Extra, Adz Colonial, Ship and R. R., 34 and 32-inch.	2.00		
No. 1	$1.60	No. 2	1.25
Extra, Pick R. R., 36-inch	2.00		
No. 1	$1.40	No. 2	1.10
Extra, Pick Square Eye Miners' 34, 33 and 32-inch.	2.00		
Extra, Square Eye Driving 34, 33 and 32-inch			
No. 1	$1.50	No. 2	1.25
Extra, Pick Square or Oval Eye Miners' or Drifting Pick, 34 and 32-inch	2.00		
No. 1	$1.45	No. 2	1.20

Sledge Hammer, Tool, Maul, Straight Taper.

	Extra.		Extra.
24-in.	No. 1, $ 65;	$ 80	34-in. No. 1, $ 95; $1.10
26-in.	No. 1, 75;	90	36-in. No. 1, 1.05; 1.20
28-in.	No. 1, 80;	95	38-in. No. 1, 1.15; 1.30
30-in.	No. 1, 85;	1.00	40-in. No. 1, 1.35; 1.40
32-in.	No. 1, 90;	1.05	42-in. No. 1, 1.60; 1.75

Blacksmith Hammer, Machinist Hammer, Hand Hammer.

	Per. doz. Extra.		Per doz. Extra.
14-in.	No. 1, 35c.;	45c.	20-in. No. 1, 65c.; 75c.
16-in.	No. 1, 45c.;	55c.	22-in. No. 1, 70c.; 80c.
18-in.	No. 1, 55c.;	65c.	24-in. No. 1, 75c.; 85c.

Adze Eye and Round Eye Hammer, 12, 13, 14, 15 in., per doz..... 30c.
Shingling and Lath Hatchet, 12, 13, 14, 15 in., per doz. 30c.
Broad Hatchet.

Per doz.		Per doz.
16-in.	50c.	18-in. 55c.
17-in.	50c.	19-in. 55c.

Dis., 10.10 and 2 %.

Hardware Specialties.

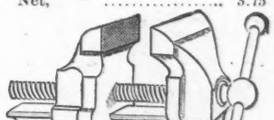
AUGERS.
Patent Adjustable Hollow.
Cuts from ¼ to 1¼, pivoted jaws, graduated scale to 1-16ths, per doz., $60.00.
Discount, 15 and 10%.

Patent Hollow Auger.

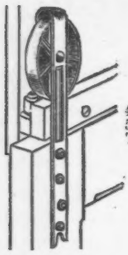
Inch	5-16	⅜	7-16	½
With bits	12.00	12.00	12.00	12.00
Without bits	8.00	8.00	8.00	8.00
9-16	⅝	¾	⅞	1
14.00	14.00	14.00	16.00	16.00
9.00	9.00	9.00	13.00	13.00
1¼	1⅜	1½		
20.00	24.00	24.00		
14.00	16.00	15.00		

Discount, 15 and 10%.

BENCH DRILL.
Adjustable bed plate.
26½ high drills to ½ in. hole, 3½ in. run of screw.
List price, each.....$10.00
Net, " 3.75

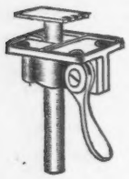


Bench Vise, Steel Jaws, 3½ in., opens 3 in.; weight, 12 lbs.; list price, each, $4.00.; net price, each, $1.60.



BARN DOOR HANGER.

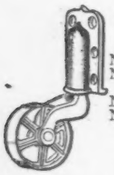
4 in., per doz. pairs.....$12.00
5 " " " 14.40
Track, per foot..... .08
One dozen pairs in case.
Dis., 50%.



BENCH HOOK.
Patent, adjustable and reversible.
List $9 dozen, ½ dozen in box.
Discount, 20 and 10%.

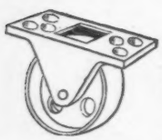
BLACKSMITH'S TONGS.
Swivel Jaw.

No. 1, 16 in., per doz.....$10.00
" 2, 18 " " 10.00
Dis. 20%.

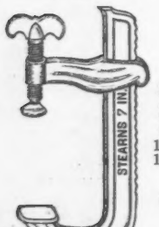


CASTERS.
Swivel Store Truck.

No. 20, japanned, 4 in. wheel, each..... .55
No. 25, " 5 " " " ..... .75
Noiseless turned wheel.
No. 30, japanned, 4 in. wheel, each..... 1.30
No. 35, " 5 " " " 1.60
Discount, 25%.



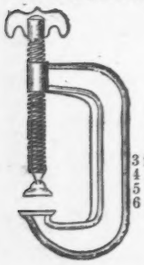
Store Truck, stationary.
No. 50, 5-inch wheel, 1½ inch wide, each, $1.05.
No. 60, 5-inch, extra heavy, 1½ inch wide, each $1.50.
Discount, 25%.



SCREW CLAMPS.
Adjustable.

3 in., per doz.....$4.00
5 " " 6.50
7 " " 9.00
9 " " 10.50
12 " " 15.00
16 " " 20.00
½ doz. in box.
Discount, 20 and 10%.

CLAMPS.
New Door Frame.
3 ft. long, per doz., $8 list; $5 per doz. net.



Malleable Iron Screw Clamps.

Per Doz.		Per Doz.	
3 in.	$7.00	7 in.	$20.00
4 "	10.00	8 "	25.00
5 "	12.00	9 "	27.50
6 "	16.00	10 "	30.00

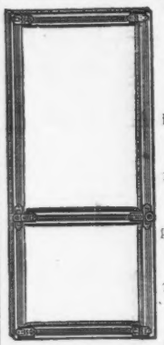
3, 4, 5, 6 in., ½ doz. in box.
Dis., 70%.

CLOTHES REEL.
Extra heavy, gray iron, japanned.
List per doz.....$15.00
Net " 7.00

JACK SCREWS.
New pattern wrought iron screw.

No.	Rise of screw.	High.	Diameter screw.	Price.
20	4½ in.	10 in.	2 in.	$4.50
25	6½ "	12 "	2 "	5.25
30	8½ "	14 "	2 "	5.75
35	11½ "	16 "	2 "	6.50

Discount, 40%.



DOOR SCREEN FRAMES.
Patent Corners.

No. 22, 3 by 7 ft. sticks, ⅞ by 2, per doz. sets, $11.
No. 24, 3½ by 8 ft. sticks, ⅞ by 2, per doz. sets, $12.
No. 26, 3 by 7 ft. sticks, ⅞ by 2½, per doz. sets, $12.50.
No. 28, 3½ by 8 ft. sticks, ⅞ by 2½, per doz. sets, $14.50.
Dis., 20%.

WINDOW SCREEN FRAMES.
Patent Japanned Corners.
No. 25, 36 by 36 corners and screws, without bead, per doz., $2.50.
No. 25, 36 by 36 corners and screws, with bead, per doz., $2.90.
No. 35, 42 by 42 corners and screws, without bead, per doz., $2.90.
No. 35, 42 by 42 corners and screws, with bead, per doz., $3.20.
Black satin stain, sticks ⅞ by 1 in.
Dis., 20%.

PULLEYS.
Side, No. 45, Japanned.

Inches...	1	1½	2	2½	3	4	5
Per doz..	.90	1.00	1.60	2.40	3.50	9.00	15.00

2 inch and under, 2 dozen in box: 2½, 3 and 4, 1 dozen in box; 5 inch, ½ dozen in box.
Discount, 50%.

PULLEY HOOK (New Floor.)
Deep cut thread, forged point.
Per doz.
¾ in. wrought iron, 8 in. long, list..... $1.90
net..... 1.00

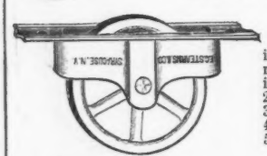
WELL WHEEL.
New pattern.
Japanned.

In.	8	10	12	14	16
Pr.d.	7.00	9.50	12.50	20.00	30.00

Discount, 70%.

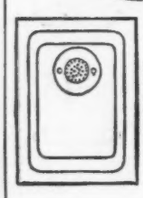
HAY FORK PULLEY.
New pattern.

No. 15, 5 in. iron wheel.....per doz. $4.50
25, 5 in. wood " ..... " 4.50
66, 6 in. " " ..... " 6.00
4 dozen in case, 8 dozen in barrel.
No. 15, per dozen, $2 net.



SHEAVES.
Patent Common
Turned and polished iron wheels, round corners, brass pin, one set in box.

2½ inch.....$1.50
3 " 1.60
4 " 2.00
5 " 2.60
Discount, 50%.



SINKS.
All 6 inch deep.

14 × 20 in....	$1.50	18 × 30 in....	$2.50
15 × 25 in....	1.75	18 × 32 in....	3.00
15 × 27 in....	2.00	18 × 36 in....	3.00
16 × 24 in....	1.80	20 × 30 in....	3.00
16 × 28 in....	2.10	20 × 36 in....	3.70
17 × 30 in....	2.25	20 × 40 in....	4.00
18 × 24 in....	2.10		

Discount, 60%.

SPOKE POINTERS.
Per doz.
No. 1, points 1⅞ in. diameter, $9.00
No. 2, points 2⅝ in. diameter, $15.00
Discount, 15 and 10%.
½ dozen in box.

VISE.
(Bench Vise, Steel Jaws.)
3½ in. opens 5 in., weight 12 lbs.
List price, each.$4.00
Net " " .. 1.60

Silent Saw Vise.
No. 10., 10 in. jaw, per doz....$15.00
Dis., 33⅓%.

Moore & Barnet Mfg. Co.

No.		per doz.	gr., lbs.
1	Amateur vise.....	$2.25	70
Anvil.			
2	.....	3.75	200
3	.....	11.25	615
4	.....	18.00	1,350
10	.....	24.00	1,675

No.		per dz.	gr., lbs.
Clamp.			
1½	.....	3.00	80
2½	.....	5.00	220
3½	.....	14.25	700
4½	.....	21.00	1,425
Combination			
4	hand.....	5.25	85

Spot cash discount, 33, 20 and 2, f.o.b.
Nos. 1, 1½, 2 and 2½ are packed in dozens; Nos. 3 and 3½ in half dozens; Nos. 4, 4½ and 10 in quarter dozens, and No. 20 singly. Each hand vise is put up in neat box and packed in half dozen lots.
1 Hinge pipe vise, 0 to 2 in. pipe.....Each $10.00
2 " " " 0 to 4 in. pipe..... 20.00
1 Malleable pipe vise, 0 to 2 in. pipe..... 8.00
1 Combination pipe and bench vise, 0 to 2 in. pipe...16.00
Discount, 50%.

WRENCHES.
Coes' Knife Handle Wrenches.

BLACK.

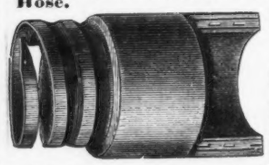
Size.	℔ doz.	Size.	℔ doz.
6 inch.....	$9.00	15 inch.....	$24.00
8 "	10.00	18 "	30.00
10 "	12.00	21 "	36.00
12 "	14.00		

BRIGHT.

4 inch..	$10.00	12 inch.....	$16.00
6 "	10.00	15 "	26.00
8 "	11.00	18 "	32.00
10 "	14.00	21 "	38.00

Discount, 55, 10, 7½ and 3%.
Coes Mechanics' Screw Wrenches, same list, less 55, 10, 10, 7½ and 3%.
A. G. Coes & Co. Pat. Screw Wrenches, same list as above. Discount, 55, 10, 7½ and 3%.

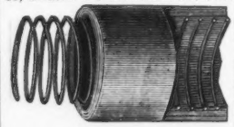
Hose.



Improved "Smooth Bore" Rubber Suction Hose.
On spiral flat or round tinned steel wire.

Int. Diam.	Per ft.	Int. Diam.	Per ft.
2 inch.....	$2.60	4 inch.....	6.50
2½ "	3.50	4½ "	7.50
3 "	4.00	5 "	8.50
3½ "	5.50	5½ "	9.50
		6 "	10.50
		6½ "	12.00
		7 inch.....	$13.50
		7½ "	15.00
		8 "	16.50
		9 "	19.50
		10 "	22.50
		12 "	27.50

Suction hose discount, high grade, 50 and 10%; Royal, 60, 10 and 5%; Manhattan, 70 and 5%.



Suction Hose.
On spiral brass or iron wire.

Int. Diam.	Per. ft.
¾-inch.....	$ .77
1 "	1.00
1¼ "	1.25
1½ "	1.65
1¾ "	2.10
2 "	2.50

Rubber Hose.
Conducting Hose—Two-ply.

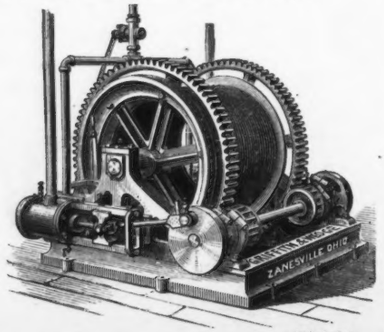
Int. diam.	Per ft.	Int. diam.	Per ft.	Int. diam.	Per ft.
⅛ in.....	$0.20	2 in.....	$0.66	5 in.....	$1.65
¾ in.....	25	2¼ in.....	75	6 in.....	1.98
1 in.....	33	2½ in.....	83	7 in.....	2.31
1¼ in.....	42	2¾ in.....	92	8 in.....	2.64
1½ in.....	50	3 in.....	99	9 in.....	2.97
1¾ in.....	58	4 in.....	1.32	10 in.....	3.33

Hydrant Hose—Three-ply.

⅛ in.....	$0.25	1½ in.....	$0.60	2½ in.....	$1.00
¾ in.....	30	1¾ in.....	70	2¾ in.....	1.10
1 in.....	40	2 in.....	80	3 in.....	1.20
1¼ in.....	60	2¼ in.....	90	3½ in.....	1.40
				4 in.....	1.60

Discount—High grade, 60; Royal, 70; Manhattan, 70 and 10 per cent.

Hoisting Engines.—Griffith & Wedge.



	Weight.	$
Hoisting Engines, Miner's Prospecting.....	4,500	750

		Weight.	$
Hoisting Engines,	No. 1 Double Cylinder...	4,500	800
	Discount, 20%.		
" "	No. 2 Double Cylinder...	6,000	1,000
" "	No. 3 " "	...11,000	1,550
" "	No. 4 " "	...15,500	1,800
" "	No. 5 " "	...17,000	2,100
" "	No. 6 " "	...13,600	1,750
" "	No. 7 " "	...17,000	2,100
" "	No. 8 " "	...19,000	2,400
" "	No. 9 " "	...48,000	4,500
	Discount, 25%.		

Webster, Camp & Lane Machine Co.

Double Cylinder Portable Hoist.

Double drum. Approx. weight, complete			Pounds.	6,000	6,500	8,000	8,500	14,000	16,000	19,000	22,000
Average Load			Pounds.	1,950	1,650	2,200	3,000	3,500	3,700	5,500	5,500
Average speed of hoist			Feet.	250	300	300	325	350	350	375	400
Pitch of groove			Inches.	3/4	3/4	7/8	7/8	7/8	1 1/8	1 1/8	
Diameter rope			Inches.	5/8	5/8	5/8	3/4	13/16	1	1	
Drum.	Capacity		Feet.	360	460	540	540	600	770	675	900
	Face		Inches.	36	36	36	36	42	48	48	60
	Diameter		Inches.	30	36	42	42	48	54	60	66
Gears.	Face		Inches.	5	5	6	6	7	8	8	8
	Pitch		Inches.	1¾	1¾	1¾	1¾	2¼	2½	2½	2½
	Pinion		Inches.	7 7/16	7 7/16	7 7/16	7 7/16	11 1/4	11 1/4	12	12
	Wheel		Inches.	46 13/16	46 13/16	51 5/16	51 5/16	66	66	73¾	73¾
Cylinders.	Horse-power			15	15	21	31	37	43.3	62	62
	Stroke		Inches.	10	10	12	12	15	15	15	15
	Diameter		Inches.	6	6	7	8¼	9	10	12	12
	Single drum		No.	5	6	7	8	9	16½	17½	18
				$825.00	918.50	1,177.00	1,331.00	1,694.00	1,914.00	2,343.00	2,475.00

Indurated Fibre Ware.

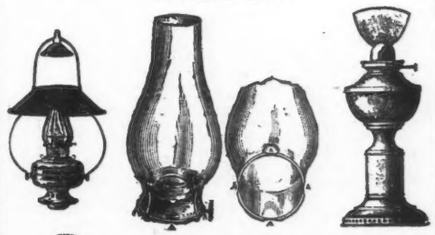
Umbrella Stands—Crated Singly.	Cub. ft.	Price per doz.
Dull finish, plain, 9 in. diam., 23 in. deep.	2	20.00
Full finish, plain, 9 in. diam., 23 in. deep.	2	24.00
Full finish, dec., 9 in. diam. 23 in. deep...	2	27.00
Waste Paper Jars—¼ doz. in crate.		
No. 1, plain, 10 in. diam., 12 in. deep.....	3	9.50
No. 2, plain, 9 " " "	2¾	7.00

Disc. 20 and 2½.

	No. doz. in crate.	Cub. ft.	Price per doz.
Ladies' or Weaver's Pails, 6 qt	1	2¾	$4.00
Half or Buggy Pails, 6 qt	1	3	3.60
Star Pails (standard plain), 12 qt. stenciled "for fire only" without extra charge	1	3½	4.50
Deck or Mason's Pails (same size as Star but heavier, with heavy wire bail)	1	4	4.95
Railroad or Fire Pails, 14 qt. (also stenciled "fire" without extra charge)	½	3½	5.85
Fire Pails, round bottoms	1	4	5.85
Milk Pails, 14 qt	1	4	5.85
Stable Pails, flush bottom, heavy wire bail, 14 qt	1	4	5.85
Stable Pails, 16 qt., same as above	½	3½	6.30
" 18 " "	½	3¾	8.00
" 20 " "	½	4	9.00
Covers for Fire or Star Pails	½	1	2.50
Hotel Knife Dishes (style A)	½	1½	6.75
Hotel Knife Dishes (style B)	1	2½	3.60
Champagne Coolers	½	2	9.00
Wash Tubs.			
No. 0, 23 in	½	12	20.25
Nos. 0, 1, 2 and 3, nested	1 n.	3½	16.87
No. 1, 21 in	½	10½	18.00
No. 2, 19½ in	½	9	15.75
No. 3, 18½ in	½	9	13.50
Nos. 1, 2 and 3, nested	½	9¾	15.75
Water Coolers.			
1 gal	1-12	1¼	24.00
2 gal	1-12	1½	30.00
4 gal	1-12	1¾	33.00
6 gal	1-12	2	36.00
"Mosaic Inlay," 3 gal	1-12	1¼	36.00
" " 4 gal	1-12	1½	42.00
" " 5 gal	1-12	1¾	45.00
" " 6 gal	1-12	2	50.00
"Fiberite" Ware.			
Fiberite Pails, 12 qt	1	3	9.00
" " 14 qt	½	3	12.00
" No. 1 Tubs	½	..	30.00
" " 2 "	½	..	27.00

Lamps.

F. H. Lovell & Co.



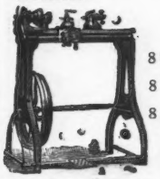
Drummond Electric Hanging Lamp, 300 candle power, complete, each $3.50.
The electric lamp, 60 candle-power.
With decorated shades, nickel, per doz. $22.00.
With opal plain shades, nickel, per doz. 18.00.
With decorated shades, brass, per doz. 21.00.
With opal plain shades, brass, per doz. 17.00.
Lamp chimney patent for Sun burners. Per doz. No. 0, 50 cents. No. 1, 60c. No. 2, 75c.

Hitchcock nickel table lamp (No. 654), each $3.75.
" " hanging " 656 " 7.25
" " bracket " 651 " 4.00
" " " with reflector 653 " 4.00
" French bronze bracket, with reflector, No. 653, each $3.75.

Harp, complete, with square tin shade, per doz., $9.50.
Complete, with Burner and chimney, per doz., $1.50.
Hurricane lanterns 25 cents extra with guards.
875, ⅝ wick, without guards, per doz., $5.00.
876, square safety lifting globe, per doz., $5.50.
877, ⅝ wick, safety lifting globe, per doz., $6.75.
Nickel plated diamond reflector reading lamp, 30 candle-power, $13.50 per doz. Net.
Illuminated night clock, per doz., $27.

Miners'.
Brass, Collar and Breast in one piece, Spout and Body in one piece.
Price, $9 per gross net.

Lathes.



S., M. & Co.'s Screw-Cutting Engine Lathes.
8 in. swing, 20 in. bet. centers, 36 in. bed, 240 lbs. weight, $60.
8 in. swing, 30 in. bet. centers, 46 in. bed, 260 lbs. weight, $70.
8 in. swing, 36 in. bet. centers, 52 in. bed, 280 lbs. weight, $75.
Boxing for export, $2.50 extra; f.o.b. at Cincinnati, 25 % dis.

Lawn Mowers.

Lloyd & Supplee's Forward Cut Mowers.

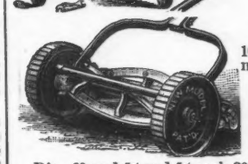
In.	Lbs.		In.	Lbs.	
10	Weight, 30¾	$13.00	16	Weight, 38	$19.00
12 "	31½	15.00	18 "	41	21.00
14 "	36	17.00	21		34.00

Dis. 60 and 5%.

Blaire Mfg. Co.

10 in.	12 in.	14 in.
$13.00	$15.00	$17.00
16 in.	18 in.	20 in.
$19.00	$21.00	$23.00

24 in., $30.00.
Geared at both ends.
Dis. 60 and 5 and 5%.



Chadborn & Caldwell Mfg. Co.

10 in. Croquet, 18 pound, mower	$11.00
10 in.	13.00
12 in.	15.00
14 in.	17.00
16 in.	19.00
18 in.	21.00
20 in.	23.00

Dis., 60 and 5% and 5% cash 30 days, f.o.b. New York.

Excelsior Three-Blade Mower and Roller.

8 in.	10 in.	12 in.	14 in.	16 in.	18 in.	20 in.
11.00	13.00	15.00	17.00	19.00	21.00	23.00

Dis. 60% and 5% cash 30 days f.o.b. New York.

New Excelsior Horse Lawn Mower.

25 in. cut, without shafts or seat		$65.00
30 " with shaft and seat		110.00
35 " " " " "		135.00
40 " " " " "		170.00
Horse boots, per set		12.00

Dis. 50%.

Lemon Squeezers.

THE ACME.

THE SAMSON

The Acme Lemon Squeezers, knife and squeezer, per dozen, $15.00.
The Samson, per dozen, $3.00.
Porcelain lined, No. 1, per doz. $6.00
25 and 30 % discount.
Wood, No. 2, per doz. $3.00
30 % discount.
Wood, common, per doz. $1.70

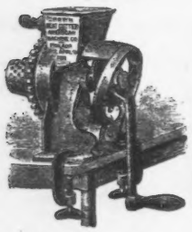
Lumber.—Soft and Hard.

Per 1000 ft.	New York.	Boston.	Per 1000 ft.	New York.	Boston.
Flooring—			Bevel siding—		
4-4 No. 1	$24.00	$26.00	No. 1	15.00	16.00
4-4 " 2	20.00	22.00	No. 2	13.00	14.00
4-4 " 3	17.50	19.50	Base Boards,		
5-4 " 1	26.50	28.50	D. 4 S—		
5-4 " 2	21.00	23.00	4-4 No. 1	26.00	28.00
5-4 " 3	18.50	20.50	4-4 " 1	22.00	24.00
Ceiling—			Stk. Boards, D		
4-4 No. 1	25.00	27.00	2 S—		
4-4 " 2	20.50	22.50	4-4 No. 1	26.50	28.50
5-8 " 1	19.50	20.50	5-4 " 1	28.50	30.50
1-2 " 1	15.75	16.75	6-4 " 1	29.50	31.50
5-8 " 2	15.75	16.75	8-4 " 1	30.50	32.50
1-2 " 2	12.25	13.25	Edge Boards,		
Partition—			D 2 S—		
4-4 No. 1	25.50	27.50	4-4 No. 1	24.50	26.50
4-4 " 2	21.00	23.00	Edge wide, D		
Ger. siding—			2 S—		
4-4 No. 2	25.00	27.00	4-4 No. 1	26.50	28.50
4-4 " 2	21.00	23.00			

5-4, 6-4, and 8-4 edge boards, $1 per M less than stock.
No. 2 stock and edge boards, $3 per M less than No. 1.
Rift flooring, $6 per M more than No. 1 flooring.
Rift flooring, P. & J., $8 per M more than No. 1 flooring.
No. 1 flooring, P. & J., $2 per M. more than P. & M.

⅜ in. black walnut	$52
½ " "	58
⅝ " "	69
¾ " "	79
1, 1¼ and 1½ in. black walnut	93
2 in. black walnut	102
2½, 3 and 4 in. black walnut	110
⅝ in. basswood	21
¾ "	24
1 to 2 in. "	26
1 to 3 in. elm	22
⅝ in. ash	66
1 "	39
1¼ and 1½ in. ash	44
2 and 2½ "	48
3 and 4 "	42
1 to 2 in. white or red oak (plain sawn)	45
½ to 4 in. white or red oak (plain sawn)	40
½ in. cherry	49
⅝ in. cherry	55
¾ "	65
1 to 2 "	90
1 to 2 in. butternut	54
1 to 2 in. hickory	45
½ in. whitewood	25
⅝ "	29
¾ "	30
1 to 2 "	33
3 and 4 "	37
1 to 3 in. maple	32
1 in. beach	28
1 in. sycamore (plain sawn)	29
1 in. sycamore (quarter sawn)	45
⅝ in. white or red oak (quarter sawn)	29
1 to 2 in. white or red oak (quarter sawn)	50
2½ and 3 in. white or red oak (quarter sawn)	55

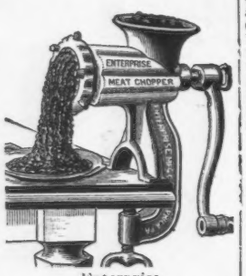
Meat Cutters.



American.

	1	2	3	4
each,	$5.00	7.00	10.00	25.00

Dis., — —.



Enterprise.

	10	12	22	32	42
each,	$3.00	2.50	4.00	6.00	15.00

Dis., 30%.

Mining Machinery.

N. B.—Special attention is invited to the goods advertised and illustrated in the advertising pages of the ENGINEERING AND MINING JOURNAL, quotations and discounts upon which would only mislead buyers.

Price-lists and other information may be obtained by addressing the advertisers direct, or by writing to the ENGINEERING AND MINING JOURNAL.

Mouse Traps.

The Cyclone Mouse Trap, per gross, $4.05.

The Idea Mouse Trap, per gross, $8.25.

Slayer Rat Traps, per gross, $10. Net prices.

Nails and Tacks.

Swedes.

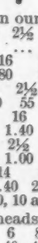
Tacks.								
Per doz.	½	¾	1	1½	2	2½	3	4
½ wt..	35	40	46	50	55	60	65	75
	6	8	10	12	14	16	18	20	24 oz.
	85	1.00	1.20	1.40	1.60	1.75	1.85	2.15	2.55
Doz. full	½	¾	1	1½	2	2½	3	4
weight	60	70	80	90	1.00	1.10	1.20	1.40
	6	8	10	12	14	16	18	20	24 oz.
	1.60	1.90	2.30	2.70	3.10	3.40	3.80	4.20	5.00
lb., bulk	½	¾	1	1½	2	2½	3	4
or paper	1.60	1.25	1.00	80	66	58	52	46
	6	8	10	12	14	16	18	20	24
	36	32	31	30	29	28	28	28	28

Discount, 67½, 10 and 2%.

O. H. Swedes.

Price, same as Swedes. Swedes steel tacks same list price as iron.

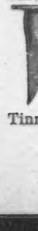
Discounts, 72½, 10 and 2%.



Upholsterers.

Price, same as Swedes.

Cut Tacks. Price per dozen ounces.



	1	1½	2	2½	3	4	6	8	10
¼ wt.					35	40	45	50	55
	12	14	16	18	20				
	60	70	80	90	1.00				
½ wt.	1	1½	2	2½	3	4	6	8	10
	45	50	50	55	60	65	70	80	95
	12	14	16	18	20				
	1.10	1.25	1.40	1.55	1.70				
Full wt.	1	1½	2	2½	3	4	6	8	
	80	90	90	1.00	1.10	1.20	1.30	1.50	
	10	12	14	16	18	20			
	1.80	2.10	2.40	2.70	3.00	3.30			

Discount, 70, 10 and 2%.

Carpet Tacks, flat and oval heads.

Blued, doz. oz.	4	6	8	10	12	14	16	18	20
¼ wt.	35	40	45	50	55	65	75	85	95
	22	24							
	1.05	1.15							
" 1½ wt.	4	6	8	10	12	14	16		
	65	70	80	95	1.10	1.25	1.40		
	18	20	22	24					
	1.55	1.70	1.85	2.00					
Tinned, doz. ¼ wt.	4	6	8	10	12	14	16		
	50	55	60	75	85	1.00	1.10		
	18	20	22	24					
	1.20	1.35	1.45	1.60					

Tinned, doz. ½ wt.	4	6	8	10	12	14
	95	1.05	1.15	1.40	1.60	1.85
	16	18	20	22	24	
	2.10	2.35	2.60	2.85	3.10	

Discount, 72½, 10 and 2%.

Finishing Nails.

Inch	⅜	3½-8	4-8	4½-8	⅝	5½-8	6-8	7-8	1
Per lb.	48	40	32	28	26	24	22	20	18

1¼ and larger. 16

Discount, 60, 10 and 2%.

Chair Nails.

Doz. ½ wt.; doz. full wt.; pound B. or P.

Inch	⅜	3½-8	4-8	4½-8	⅝	5½-8	6-8	7-8
Per lb.	51	43	35	31	29	27	25	23
	1	1½						
	21	19						

Discount, 60, 10 and 2%.

Common and patent brads.

inch.	Price per doz. ½ wt.	Price per doz. full wt.	Price per lb. in papers or bulk.
2-8	.50	1.00	1.25
3-8	.60	1.20	.80
4-8	.65	1.30	.58
5-8	.72	1.44	.48
6-8	.80	1.60	.36
7-8	.90	1.80	.30
1	1.00	2.00	.26
1⅛	1.12	2.24	.25
1¼	1.26	2.52	.24
1½	1.82	3.64	.22
1¾	2.25	4.50	.20
2	2.43	4.86	.18

Dis. 60, 10 and 2%.

Oars.

Best quality selected White Ash.

	Cents.		Cents.
6 to 12 ft., per sq. ft.	7	22 ft., per sq. ft.	14
13 " 16 " " "	8	24 " " "	18
17 " 18 " " "	8½	25 " " "	20
19 " " "	10		
20 " " "	11		

5 and 2½ cash.

Oils.

LUBRICATING.—Fiske Bros.

Lubroleine A cylinder oil 50 in. barrels.
Lubroleine D cylinder oil 40 in. barrels.
Lubroleine A machine oil 45 in. barrels.
Lubroleine B machine oil 35 in. barrels.
Lubroleine A engine oil 50 in. barrels.
Lubroleine B engine oil 40 in. barrels.
In cases 5c gal. extra.

Crescent Axle Grease.—Barrels, 3c per lb; 100-lb. kegs, 3½c lb.; 2-lb. decorated tins, $12, gross less 5 per cent.

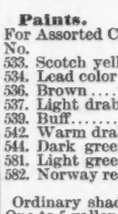
Texas Star Axle Grease.—Barrels, 2½c per lb.; 100-lb. kegs, 3c per lb.

Oil Stones.

Best White Washita.		
Green Paper Brand, 8 × 2 × 1⅛ inches	per lb.	.32
Oil stone, No. 1,	" "	.22½
" Extra,	" "	.30
High rounds,	" "	.30
Round edge slips, Nos. 1, 3½ to 5, in boxes 10 lbs. upwards	"	.40
Round edge slips, extra, in boxes 10 lbs. upwards	"	.50
Pen knife pieces, ass't 3 to 5 × 1 × 1⅜, in boxes 10 lbs. upwards	"	.50
Needle pieces	per hundred.	$5.00
Wheels, 1½ to 5¾ in. thick	per inch.	.40
Good Washita,		
Oil Stone No. 1, 8x2x1⅛	per lb.	.15
" " 2, "	"	.12
Axe Stone, assorted sizes	"	.10
Round Edge Slips, assorted sizes	"	.25
Arkansas.		
Oil Stone No. 1, 4 to 6 in. long x2x¾ to 1 in.	per lb.	$1.35
Oil Stone No. 1, 6 to 9 in. long x2x¾ to 1 in.	"	1.75
Oil Stone No. 2, 4 to 9 in. long x2x¾ to 1 in.	"	.75
Round Edged Slips, assorted sizes	"	2.00
Square File Slips, 3 to 4 inches long	per doz.	1.75
Diamonds, 3½ to 4 inches long	"	3.00
Triangulars, 3½ to 4 inches long	"	3.00
Flat Files, 3 to 4 inches long	"	2.00
Beveled Files, 3½ to 4 inches long	"	2.50
Knife Blades, 3 to 4 inches long	"	3.00
Points, extra long, 3 to 3½ inches	"	2.00
Points	"	1.50
Pen Knife Pieces, assorted sizes	per lb.	2.00
Needle Pieces	per hund.	8.00
Wheels, 2 to 4 inches, ½ inch thick	per inch	1.25
Oil Stone Powder	per lb.	15

10, 10 and 2½ dis.

Oil Stoves.



Burns 8 hours; holds 1 quart oil.

Nickel plated crown plate, per doz' $12.

Paints.

For Assorted Cans of 1, 2, 3 and 5 pounds. 100-lb. cases.

No.	lb. c.	No.	lb. c.
533. Scotch yellow	18	583. Black	18
534. Lead color	18	584. Dark blue	25
536. Brown	18	585. Chrome yellow	30
537. Light drab	18	586. Vermilion	30
539. Buff	18	587. Indian red	25
542. Warm drab	18	588. Bronze green	25
544. Dark green	25	589. Quaker green	25
581. Light green	25	546. Inside white	18
582. Norway red	18	547. Outside white	18

Discount 50 per cent.

Ordinary shades. Per gal.		Per gal.
One to 5 gallon cans	$1.90	Half gallon cans $2.00

Tuscan Red, Green and Yellow.

Per gal.		Per gal.
One to 5 gallon cans	$3.10	Half gallon cans $3.30

Vermilion.

Per gal.		Per gal.
One to 5 gallon cans	$5.00	Half gallon cans $5.20

Discount 40 per cent.

The list in barrels, half-barrels and kegs (of 5 gallons or larger) will be 10c. a gallon less than in gallon cans. Kegs of less than 5 gallons will be charged at gallon price. One-quarter gallon cans not put up. Special shades made to order.

Special cash discount for large orders.

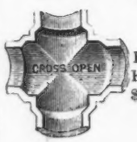
Pipe Covering.

Magnesia Sectional Covering.

For Wrought Iron Pipe. In Canvas Jacketed Sections, 36 inches in length.

Inside dia. of pipe.	Weight of cover per lineal ft.	Price per lineal foot canvas jacketed.
½ in.	8 ozs.	$0.25
¾ "	9 "	0.25
1 "	10 "	0.25
1¼ "	12 "	0.25
1½ "	15 "	0.25
2 "	18 "	0.27
2½ "	20 "	0.31
3 "	24 "	0.36
3½ "	26 "	0.40
4 "	30 "	0.44
4½ "	38 "	0.47
5 "	40 "	0.50
6 "	48 "	0.60
7 "	55 "	0.65
8 "	65 "	0.75
9 "	75 "	0.80
10 "	85 "	0.90

Elb'ws.	Tees.	G Valv's.	Crosses.	Unions.
$0.20	$0.30	$0.25	$0.35	$0.30
0.25	0.33	0.25	0.43	0.33
0.25	0.33	0.25	0.43	0.33
0.25	0.33	0.25	0.43	0.33
0.25	0.33	0.25	0.43	0.33
0.27	0.36	0.27	0.48	0.33
0.31	0.41	0.41	0.53	0.41
0.36	0.48	0.48	0.60	0.48
0.40	0.53	0.53	0.68	0.53
0.44	0.59	0.59	0.75	0.59
0.50	0.65	0.65	0.80	0.63
0.58	0.75	0.75	0.90	0.67
0.65	0.90	0.90	1.00	0.77
0.83	1.20	1.20	1.10	0.90
1.00	1.35	1.35	1.20	1.00
1.10	1.50	1.50	1.35	1.10
1.25	1.75	1.75	1.50	1.25



Magnesia Plastic Covering (dry)—Prepared Carbonate Magnesia and Fiber, for Trowel Work per barrel, $8.00

Dis. 25%.

Portable Houses.

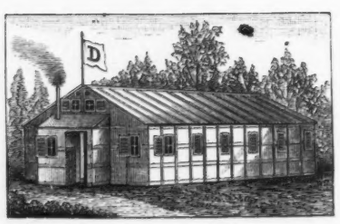
Ducker Portable House.

Weight, 450 lbs.

Price, $150.

Closes securely.

Dis., 10%.



Weight, 85 lbs. per section.

Price, $220.

Dis., 10%.

Weight, complete, 5600 pounds.

No. 10.—26 × 33 ft., including veranda and rear extension. Main part, 19 × 26 ft. $500.00

	No. 1. Veranda on side.	No. 2. Veranda on end.	No. 3. without veranda.
12 × 12, 1 door, 3 windows,	$120.00	$120.00	$105.00
12 × 14, 1 " 3 "	135.00	130.00	120.00
12 × 17, 1 " 3 "	155.00	150.00	135.00
12 × 19, 2 " 4 "	175.00	165.00	150.00
12 × 21, 3 " 5 "	190.00	180.00	165.00
12 × 23, 3 " 5 "	200.00	190.00	175.00
12 × 26, 3 " 5 "	220.00	205.00	190.00
14 × 21, 3 " 5 "	205.00	195.00	180.00
10 × 12, 1 " 3 "		100.00	90.00
10 × 14, 1 " 3 "		105.00	95.00
7 × 10, 1 " 2 "			65.00
7 × 12, 1 " 2 "			75.00
7 × 14, 1 " 2 "			85.00

Hunter's Cabins.

7 × 12, with 4 berths	$80.00
7 × 14, " 4 "	90.00

Discount, 20%.

Post Hole Diggers.

Little Giant	$36.00	doz 11 cu ft.
Hercules	30.00	" " " "
New Champion	20.00	" " " "
Scheidler	36.00	" " " "

Dis. 40% f.o.b. New York or Boston.

Press.

Combined press for cutting, forming, horning and seaming.

Particulars of flat front presses, including beds, slides, bolsters, plates, etc.

Prices are net, delivered on steamers in New York, including insurance, etc.

Nominal size of press	41	42	43	44	45
Price, including et ceteras	$130	$200	$260	$420	$660
Weight, about lbs	600	1050	1900	3600	7200
Greatest diameter that can be wired ins	5	7	10	14	20
Greatest depth that can be wired ins	8	10	13	16½	20
Hole through bed—circle intersecting ins	4½	6	8½	12	17
Hole through back—width ins	8	9½	12	15½	20½
Width between die clamps—clear ins	8	11	15	20	27
Distance back from center of slide bar ins	4½	5½	7	9	12
Height to slide-bar, when up ins	5¼	6½	7½	8½	9
Stroke of slide-bar ins	1	1¼	1½	1¾	2
Adjustment of slide-bar ins	1	1¼	1½	1¾	2
Diameter of fly-wheel ins	20	26	32	38	44
Width of fly-wheel ins	3	4	5	6	7
Weight of fly-wheel, about lbs	125	250	420	725	1100
Speed per minute, about rev	120	110	100	90	80
Cubic feet boxed, about	30	40	50	60	70

Printers' Sundries.

Vanderburgh, Wells & Co.

Wood rules, 12 cents per yard.

Wood rules, on end wood, 15 cents per foot.

EUREKA STAND.

12 full cases.

Price without cases $12.00

Boxing and cartage 1.25

CASE RACKS.

	In. High.	Plain.	Inclosed sides and back.
Single, to hold 12 cases,	41¼	$6.00	$8.50
" " 16 "	50¾	7.00	9.50
" " 20 "	60¼	8.00	11.00
" " 24 "	69¾	9.00	12.00
" " 30 "	84	10.00	13.50
Double, to hold 32 "	50¾	12.50	16.00
" " 40 "	60¼	14.00	17.50
" " 60 "	84	18.00	23.00

When required we make inclosed case racks trimmed with moldings, and painted or grained. Locking bars, to prevent cases from being removed, furnished to order.

TYPE CASES.

Full Size.

	Strong slat.
No. 1—Pairs (News) per pair,	$1.75
3—German "	1.75
4—Music "	3.50
4½—Music "	3.50
5—Greek "	3.50
6—Hebrew "	3.50
7—Job (Italic) each	1.00
7½—New York Job "	1.00
8—Triple "	1.00
8½—Paterson Job "	1.00
9—Yankee Job "	1.00
10—Lead, No. 1 "	1.00
11—Lead, No. 2 "	1.00
12—Lead, No. 3 "	1.00
13—Quad, No. 1 "	1.00
13½—Quad, No. 2 "	1.25
14—Labor Saving Rule, No. 1 "	1.20
15—Labor Saving Rule, No. 2 "	1.20
16—Labor Saying Rule, No. 3 "	1.20
17—Slug "	1.00
18—Border "	1.00
19—Blank or Cut "	
19½—Improved Wood Type "	
20—Sort, No. 1, extra deep "	1.50
41—Sort, No. 2, extra deep "	1.50

PROOF GALLEYS.

All Wood.

Single column, 4½ × 25 inches inside $0.80

Double " 7 × 25 " " 90

Brass Bottom.

Single column, 3⅝ × 23¼ inches inside $1.25

Double " 6¾ × 23¼ " " 1.50

Half Lined.

Single column, 3⅝ × 23¼ inches inside $1.76

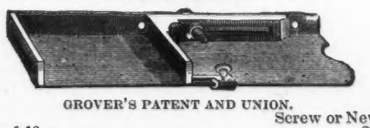
Double " 6¼ × 23¼ " " 2.25

All Brass.

Single column, 3¾ × 23¾ $2.50

Double " 6¼ × 23½ 3.00

COMPOSING STICKS.



GROVER'S PATENT AND UNION.

	Screw or News.
6 in.,	1.10 ..... $ .75
8 "	1.20 ..... .80
10 "	1.40 ..... 1.00
12 "	1.60 ..... 1.15
14 "	1.80 ..... 1.30
16 "	2.00 ..... 1.45
18 "	2.20 ..... 1.60
20 "	2.40 ..... 1.75

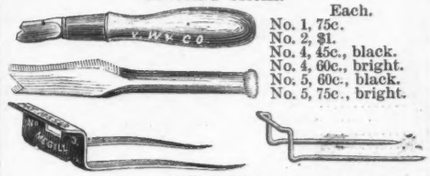
Composing rules, 14 ems pica and under, 25 cents.

GALLEY RACKS.

8 in.,	5 ft. high	$3.00
10 "	5 ft. 8½ in. high	3.50
12 "	6 ft. 7 in. high	4.25
15 "	8 ft. high	5.25
20 "	9 ft. 8 in. high	7.00

Arms, per pair, 35 cents.

SHOOTING STICKS.



Each.

No. 1, 75c.
No. 2, $1.
No. 4, 45c., black.
No. 4, 60c., bright.
No. 5, 60c., black.
No. 5, 75c., bright.

GAUGE PINS.

Improved brass gauge pins, 40c. doz., all sizes.
Improved wire gauge pins, 25. doz., all sizes.
Improved steel gauge pins, 60c. doz., all sizes.
Improved golden gauge pins, 40c. doz., all sizes.

MITRE BOXES.

Regular size, 2 in., 50c. each.
Extra size, 3½ in., 75c. each.

LEAD CUTTER.

Curtis' Lead Cutter $2.00

PROOF PRESS, " OUR OWN."

9 × 32, complete, with Brayer $28.00

Pumps.

W. & B. Douglas—1. 57. 70.

No. 0. 1. 2. 3. 4. 5. 6.

$3.50. $4. $4.50. $5. $5.50. $6.50. $8.00.

Dis. 60 and 5%.

Rumsey & Co. (See advertisement).

Prices on all pumps include cylinders.

No.	Dia. Cyl.	Suction.	Cap. stroke.	Price—Iron.	Price—Brass cyl.
0	2 in.	1 in.	1-15 gal.	$3.50	.....
1	2¼ "	1 "	1-12 "	4.00	$6.00
2	2⅝ "	1¼ "	1-11 "	4.50	7.00
3	2⅞ "	1¼ "	1-10 "	5.00	8.00
4	3 "	1¼ "	1-6 "	5.50	10.00
5	3¼ "	2 "	1-5 "	6.50	14.00
6	3½ "	2 "	1-4 "	8.00	18.00
7	4 "	2½ "	1-3 "	12.00	20.00

Dis., 65%.

1	2½ in.	1¼ in.	1-10 gal.	4.25	.....
2	3 "	1¼ "	1-7 "	4.75	.....
3	3½ "	1¼ "	1-5 "	5.25	.....
4	4 "	1½ "	1-4 "	5.75	.....
5	4½ "	1½ "	1-3 "	6.25	.....

Dis., 70%.

Standard and Cylinder for 1½ in. Iron Pipe, $16.00.

Dis., 55%.

No. 6½, standard and cylinder, 1¼ in. pipe, $13.00.

No. 7½, standard and cylinder, 1¼ in. pipe, $15.00.

No. 8½, standard and cylinder, 1¼ in. pipe, $18.00.

With hose and discharge pipe, add $3.00 to list price.

Dis. 55%.

No. 1, diam. cyl., 2½ in.; cap. stroke, 1-8 gal.; size pipe, 1¼ in. Price, iron, $12.50; brass cyl., $17.50.

No. 2, diam. cyl., 3 in.; cap. stroke, 1-6 gal.; size pipe, 1¼ or 1½ in. Price, iron, $14.50; brass cyl., $18.50.

No. 3, diam. cyl., 4 in.; cap. stroke, 2-5 gal.; size pipe, 1½ or 2 in. Price, iron, $23.50; brass cyl., $34.50.

Dis., 55%.

No. 1, diam. cyl., 3 in.; suction, 1¼ in.; cap. stroke, 3-10 gal. Price, iron, $28.00; brass cyl., $58.00.

No. 2, diam. cyl., 4 in.; suction, 1½ in.; cap. stroke, 1-2 gal. Price, iron, $32.00; brass cyl., $60.00.

No. 3, diam. cyl., 5 in.; suction, 2 in.; cap. stroke, 6-7 gal. Price, iron, $35.00; brass cyl., $90.00.

No. 4, diam. cyl., 6 in.; suction, 2½ in.; cap. stroke, 1 1-5 gal. Price, iron, $45.00; brass cyl., $120.00.

Dis., 45%.

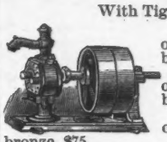
No.	Diam. cyl.	Cap. stroke.	Stroke.	Pipe.	Price.
0	2 in.	1-11 gal.	7 in.	1 in.	$21.50
00	2½ "	1-7 "	7 "	1¼ "	23.00
1	3 "	1-5 "	7 "	1½ "	25.25
2	3½ "	1-3 "	7 "	1½ "	27.25
3	4 "	4-10 "	7 "	2 "	30.50
3½	4½ "	1-2 "	7 "	2 "	37.50
4	5 "	8-10 "	10 "	2½ "	44.00
4½	5½ "	1 "	10 "	2½ "	47.00
5	6 "	1 1-5 "	10 "	3 "	50.00

Dis., 40%.

No.	Diam. cyl.	Cap. stroke.	Diam. pipe.	Price—Iron.	Price—Br's cyl.
1	2 in.	1-5 gal.	1 in.	$39	$51
2	2½ "	1-3 "	1¼ "	41	56
3	3 "	1-2 "	1½ "	45	62
4	3½ "	6-7 "	2 "	51	81
5	4 "	7-8 "	2 "	63	114
6	4½ "	1 "	2 "	80	155

Dis., 40%.

With Tight and Loose Pulleys.



No. 1, cap. per rev., 1-6 gal.; size of pipe, 1¼ in.; price, iron, $26; bronze, $45.

No. 2, cap. per rev., 1-5 gal.; size of pipe, 1½ in.; price, iron, $31; bronze, $55.

No. 4, cap. per rev., 1-3 gal.; size of pipe, 2 in.; price, iron, $48; bronze, $75.

Pulleys on Nos. 1 and 2 are 8 in. diam., 2½ in. face; on No. 4, 12 in. diam., 3½ in face.

Balance wheels for above pumps. $1, $2, and $3, according to size.

Dis., 45%.

No. 2, ½ to 2 gal. per min.; length of drive pipe, 25 to 40 ft.; calibre of pipes, drive, ¾ in.; discharge, ⅝ in.; price, $9.

No. 3, 1 to 4 gal. per min.; length of drive pipe, 25 to 40 ft.; calibre of pipes, drive, 1 in.; discharge, ⅝ in.; price, $11.

No. 4, 2 to 8 gal. per min.; length of drive pipe, 25 to 40 ft.; calibre of pipes, drive, 1½ in.; discharge, ½ in.; price, $14.

No. 5, 3 to 14 gal, per min.; length of drive pipe, 25 to 40 ft.; calabre of pipes, drive, 2 in.; discharge, 1 in.; price, $22.

No. 6, 4 to 25 gal. per min.; length of drive pipe, 30 to 40 ft.; calibre of pipes, drive, 2½ in.; discharge, 1¼ in.; price, $40.

No. 7, 8 to 60 gals. per min.; length of drive pipe, 30 to 40 ft.; calibre of pipes, drive, 4 in.; discharge, 2 in.; price, $75.

No. 8, 12 to 120 gal. per min.; length of drive pipe, 30 to 50 ft.; calibre of pipes, drive, 6 in.; discharge, 2½ in.; price, $125.

Dis., 45%.

Rules.

"Lufkin." Steel Rules, per doz.

	Rules only.	In leather cases.
No. 31, 1 ft. folding pocket	$4.00	$5.50
" 31, 2 " " "	8.00	10.00
" 41, 1 " " "	4.00	5.50
" 41, 2 " " "	7.50	9.50
" 41, 3 " " "	11.00	13.50
" 41, 4 " " "	14.50	17.00

	1 ft.	2 ft.	3 ft.
No. 60, ¾ × 21 gauge	$4.00	$8.00	.....
No. 62, 1¼ × 16 "	8.00	15.00	$22.00

Discount, 60 and 10%.

Tinner's Rules.

No. 95, 3 ft. circumference rules ..... each $2.50

No 95, 4 ft. " " " " 3.00

Discount, in dozen lots, 50%.

	₰ doz.
No. 51, 3½ ft. steel board rules	$42.00
No. 52, 3 " " "	36.00
No. 52½, 2½ ft. " "	33.00

Discount, 50%.

Sad Irons. (Mrs. Potts' Patent).

American Machine Co.

With detachable wood handles, in sets of 3 irons, 1 handler, 1 stand (1 each Nos. 1, 2 and 3 iron weighing 4, 5 and 6 pounds respectively.)

	D'ble Pointed. Nickel Plated	D'ble Pointed. Plain P'l'sh'd	Square Back. Nickel Plated	Square Back. Plain P'l'sh'd
No.	150	155	160	165
Price per doz. sets	$30.00	$24.00	$30.00	$24.00
Irons not in sets, either in Nos. 1, 2 or 3, with handles, per doz.	12.50	10.50	12.50	10.50
Without handles, per doz.	8.50	6.50	.50	6.50
No. 4 iron, extra heavy, weight 7 lbs., with handles, per doz.	.....	.....	15.00	15.00
Without handles, per doz.	.....	.....	11.00	8.00

Polishing irons with handles.

(Double point.)

	Large size, weight 4½ lbs. each. Nickel Plated	Large size, weight 4½ lbs. each. Plain P'l'sh'd	Small size, weight 3 lbs. each. Nickel Plated	Small size, weight 3 lbs. each. Plaid P'l'sh'd
No.	180	185	182	187
Price per doz.	$15.00	$3.00	$11.00	$9.00

Girls' irons with handles.

Same as No. 1 iron in set, but smaller size. Weight, 2 lbs each.

(Double point.)

Nickel plated, No. 190, per doz	$7.50
Plain polished, No. 195, per doz	6.00
Extra handles for any size, per doz	4.00
Extra stands for any size, per doz	.60

Star Irons,

With Perforated Iron Handle. Not detachable. Assorted either No. 1, 2 or 3 sizes, correspond to the detachable handle irons in sets.

	D'ble pointed. Nickel Plated	D'ble pointed. Plain Plish'd	Square back. Nickel Plated	Square back. Plain P'l'sh'd
No.	70	75	71	76
Price per doz.	$7.25	$5.50	$7.25	$5.50

Polishing Irons.

Small Size. 3 lbs each. Doubled Pointed.

Nickel Plated. No. 72, per doz. $7.25 | Plain Polished. No. 77, per doz. $5.50

Girls' Irons.

Double-pointed, 2 lbs. each; similar to detatchable handle irons.

Nickel-plated, No. 100 ..... $5 per doz

Plain polished, No. 105 ..... $3.75 "

Toy Irons.

Weight, 14 ounces each, nickel-plated (No. 110), $3.25 per dozen; plain polished (No. 115), $2.50 per dozen.

Weight, 5 ounces each, nickel-plated (No. 120), $2 per dozen; plain polished (No. 125), $1.05.

Discount on all Sad Irons 50 and 5%.

Slate Roofing.

F. o. b. New York. Stowage allowed.

Purple and Green, per 100 feet sq	$4.50
Dark blue, per 100 feet sq	4.10

Sizes, 24 × 12 = 115 to sq., 650 lbs. weight.

Sizes, 20 × 10 = 170 to sq., 650 lbs. weight.

Sash Chains.

No. A. "Giant" metal, 15c. pr. ft., wts. not over 125 lbs.
No. 1. "Giant" metal, 12c. pr. ft., wts. not over 75 lbs.
No. 2. "Giant" metal, 10c. pr. ft., wts. not over 40 lbs.
No. 0. "Giant" metal, 8c. pr. ft., wts. not over 25 lbs.
No. 1. Red metal, 10c. pr. ft., wts. not over 40 lbs.
No. 2. Red metal, 8c. pr. ft., wts. not over 30 lbs.
No. 0. Red metal, 6c. pr. ft., wts. not over 15 lbs.
No. 1. Steel, 8c. pr. ft., wts. not 75 lbs.
No. 2. Steel, 6c. pr. ft., wts. not over 30 lbs.
No. 0. Steel, 4c. pr. ft., wts. not over 15 lbs.
No. 1. Steel, black enameled, 9c. pr. ft., wts. not over 75 lbs.
No. 2. Steel, black enameled, 7c. pr. ft., wts. not over 30 lbs.
No. 0. Steel, black enameled, 5c. pr. ft., wts. not over 15 lbs.

Fastenings for hanging a window of 2 sashes for Nos. 1 and 2 chains, consisting of 4 hooks, 4 rings, 4 sash irons, a set, 18c. per set.

Fastenings for hanging a window of 2 sashes for No. 0 chains, 14c. per set.

Dis. on "Giant" metal chain 40 10 10%
" " Red metal chain..... 40 10 10 10%
" " Steel " " 40 10 10 10%
" " Fastenings..... 40 10 10%

Scales.—Discount on all scales 50 per cent.

Postal scales.

No. 1, capacity ½ to 9 oz., $3.00.
No. 2, capacity ½ to 12 oz., $4.00.
No. 3, capacity ½ to 34 oz., $6.00
No. 4, capacity ½ oz. to 4 lbs., $8.00

Even balance trip scales seamless scoop, with weights.

No. 1, capacity ½ oz. to 2 lbs., tin scoop, $5.50; brass scoop, $6.50.
No. 2, capacity ½ oz. to 4 lbs., tin scoop, $6.50; brass scoop, $7.50.
No. 2½, capacity ½ oz. to 18 lbs., tin scoop, $11; brass scoop, $12.50.

Butter Trip Scales, slab, weights and scoop.

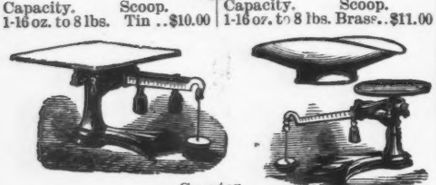
No. 7, ½ oz. to 10 lbs., 10 in. slab, without side beam $10.50
" " " " " " " with " 11.50
" 8 " " 20 lbs., 12 in. " without " 12.50
" " " " " " " " " 13.50

Tea Scales—All Seamless Scoops.

Capacity.	Scoop.	Capacity.	Scoop.
¼ oz. to 10 lbs.	Tin ..$8.00	¼ oz. to 10 lbs.	Brass ..$9.00

Druggists.

Capacity.	Scoop.	Capacity.	Scoop.
1-16 oz. to 8 lbs.	Tin ..$10.00	1-16 oz. to 8 lbs.	Brass..$11.00



Counter.

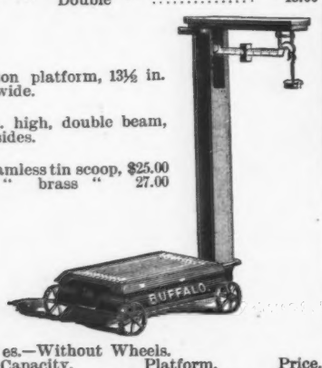
Capacity.	Scoop.	Capacity.	Scoop.
½ oz. to 36 lbs.	Tin ..$10.00	½ oz. to 36 lbs.	Brass..$12.00

Grocer.

Capacity.	Scoop.	Capacity.	Scoop.
½ oz. to 62 lbs.	Tin ..$12.00	½ oz. to 62 lbs.	Brass..$14.00

Meat or Butter Scales, with Slab.

½ oz. to 62 lbs., with Single Beam.....$14.00
" " " " " Double " 15.00



Patent Boston platform, 13½ in. long by 10 in. wide.

Pillar, 18 in. high, double beam, marked both sides.

With large seamless tin scoop, $25.00
" " " brass " 27.00

Platform scales.—Without Wheels.

No.	Capacity.	Platform.	Price.
1	400 lbs.	21½ by 15 inches.	$23.00
2	600 lbs.	25 by 16 "	30.00
3	800 lbs.	25 by 17 "	34.00
4	1,000 lbs.	26 by 17 "	39.00
5	1,200 lbs.	28 by 20 "	45.00
6	1,600 lbs.	29 by 21 "	55.00
7	2,000 lbs.	32 by 23 "	70.00

With Wheels.

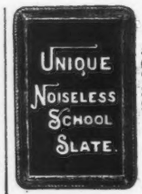
No.	Capacity.	Platform.	Price.
1	400 lbs.	21½ by 15 inches.	$26.00
2	600 lbs.	25 by 16 "	33.00
3	800 lbs.	25 by 17 "	38.00
4	1,000 lbs.	26 by 17 "	43.00
5	1,200 lbs.	28 by 20 "	49.00
6	1,600 lbs.	29 by 21 "	60.00
7	2,000 lbs.	32 by 23 "	75.00

Brass sliding poise at same price if so specified in order

With Wheels and Drop Lever.

No.	Capacity.	Platform.	Price.
4	1,000 lbs.	26 by 17 inches.	$51.00
5	1,200 lbs.	28 by 20 "	59.00
6	1,600 lbs.	29 by 21 "	70.00
7	2,000 lbs.	32 by 23 "	82.00
8	2,500 lbs.	33¼ by 24¾ "	94.00
9	3 000 lbs.	38 by 30 "	125.00

School Slates.



Noiseless School Slates.

Winsboro Cord Bound.

Size.	Doz. in case.	Price per case.
5 by 7	18	$18.00
6 by 9	12	15.00
7 by 11	10	14.40
8 by 12	8	14.00
9 by 13	6	12.00

Dis., 50 and 2½%.

"D" School Slates.

Winsboro Oval Round Corner.

	Doz. in case.	Price per case.
4 by 6	24	$10.80
5 by 7	18	9.00
6 by 8	12	8.20
6 by 9	12	8.64
6½ by 10	12	9.00
7 by 10	10	7.70
7 by 11	10	8.00
8 by 12	8	8.00
9 by 13	6	7.20

Dis., 200 case lots, 50 and 2½%.

Shears. The Patent "Eureka."

No. 1 cuts round metal up to ¼ in., steel to ⅛, $12.

No. 2 cuts round metal up to ⅛ in., steel to 3-16, $20.

Discount, 25%.

Soups (French). Franco-American Brand

	Per dozen. In Cans—Quarts.	Pints.	In Glass. 1½ pt.
Green turtle	$8.00	$4.32	$9.00
Terrapin			
Chicken	3.75	2.25	
Mulligatawny			
Mock turtle			
Ox tail			4.50
Consommé			
Tomato			
Julienne			
Printanier	3.50	2.10	

French bouillon	None in glass.
Mutton broth	
Vegetable	
Beef	
Pea	

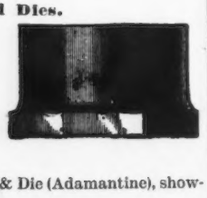
Packed in cases of..... 2 doz. 4 doz. 1 doz.

Regular Assorted Cases. In Cans—Quarts.
2 Chicken, 1 Mulligatawny, 3 Mock Turtle, 3 Ox Tail, 2 Consommé, 2 Tomato, 3 Julienne, 1 Printanier, 1 Mutton Broth, 1 Vegetable, 1 Beef, 2 French Bouillon, 2 Pea. Per doz., $3.55.

In Glass.
1 Chicken, 1 Mulligatawny, 2 Mock Turtle, 1 Ox Tail, 2 Consommé, 2 Tomato, 1 Julienne, 1 Printanier, 1 Mutton Broth.

Terms cash. Discounts: 5% for lots of 10 cases, 10% for lots of 25 cases, 15% for lots of 50 cases.

Stamp Head Shoes and Dies.



Shoe & Die (Adamantine), showing even wear from end to end.

Chrome Steel Works.

8 cents per lb f.o.b. New York.

Tools.

ARTISANS.

Chisel (Mason).

Stone, 5 and 8c. lb., net.

Mill Picks.
Cast steel, 2 to 3 lbs., $22 per doz.
Dis., 60 and 5%.

Stone Axes, Cast Steel.

All sizes, 50c. per lb.

Dis., 70 and 10%.

Five lbs. and over, 40c.; with teeth, 45c.; 3 to 5 lbs., 45c.; with teeth, 50c.; under 3 lbs., 50c.; with teeth, 55c.

Nos. 40 and 41, spalling or stone hammer, 5 lbs. and over, 36c.; 3 to 5 lbs., 40c.; under 3 lbs., 45c. per lb.

Nos. 40 and 41, spalling hammers, 9 to 20 lbs., steel face, per lb., 17c.

Dis., 70 and 10%

Ship or Top Mauls, Steel Face, 4 to 8 lbs., 28c. per lb.

Dis., 50, 10 and 5%.

Steel Wedges, wood, 1st qual., 5c. lb.

Cooper Froes.

8 in..	℔ doz. $13.00
10 in..	℔ doz. 13.50
12 in..	℔ doz. 14.00
14 in..	℔ doz. 14.50
16 in..	℔ doz. 15.00

Discount, 60%.

60 days, 2% 10 days.

Vise.

No 1. Solid Box Vises.

	Each.
No. 25, 3⅜ in. Jaw	$12.00
" 30, 3½ "	11.00
" 55, 3⅞ "	10.00
" 40, 4 "	10.50
" 45, 4¼ "	11.00
" 50, 4½ "	11.50
" 55, 4½ "	12.00
" 60, 4½ "	13.00
" 65, 4¾ "	14.00
" 70, 5 "	15.00
" 75, 5 "	16.00
" 80, 5¼ "	17.50
" 85, 5¼ "	18.50
" 90, 5½ "	20.00
" 95, 5¾ "	21.00
" 100, 6 "	22.00
" 105, 6 "	23.00
" 110, 6¼ "	24.00
" 115, 6¼ "	25.00
" 120, 6½ "	26.00
" 125, 6½ "	27.50
" 130, 6¾ "	29.00

	Each.		Each.
No. 135, 6¾ in. Jaw	$31.50	No. 170, 7¼ in. Jaw	$44.50
" 140, 7 "	33.00	" 180, 8 "	47.00
" 145, 7 "	35.00	" 190, 8 "	53.00
" 150, 7 "	36.00	" 200, 8 "	56.00
" 160, 7¼ "	41.50		

Dis., 60 and 10%.

MINERS.

Coal Picks.

No.		Per doz.
16, Weight, 2	lbs	$8.50
16, "	2½ "	9.00
16, "	3 "	9.50
16, "	3½ "	10.00
16, "	4 "	10.50
16, "	4½ "	11.00
16, "	5 "	11.50
16, "	5½ "	12.00
16, "	6 "	12.50
16, "	6½ "	13.00
16, "	7 "	14.00

Packages charged at cost.
Dis., 60%.

Adze Eye Coal Picks.
Same list and dis. as No. 16.

Anthracite Coal Picks.
Same list and dis. as No. 16.

Stone Picks, per doz.
No. 18, 6 to 7 lbs...$16.50.
No. 18, 7 to 8 lbs... 17.50.
No. 18, 8 to 9 lbs... 18.50.
Dis., 60 and 5%.

Adze Eye Miners' Picks—Surface, Drifting and Poll.

No.		Per doz.
19, Surface.	No. 1, 4 lbs	$14.00
19, "	No. 2, 4½ "	15.00
19, "	No. 3, 5 "	16.00
19, "	No. 4, 5½ "	17.00
19, "	No. 5, 6 "	18.00
19, "	No. 6, 6½ "	19.00
19, "	No. 7, 7 "	20.00
20, Drifting,	No. 1, 3 "	12.50
20, "	No. 2, 4 "	14.00
20, "	No. 3, 4½ "	15.00
20, "	No. 4, 5 "	16.00
20, "	No. 5, 6 "	17.50
21, Poll,	No. 1, 3½ "	15.00
21, "	No. 2, 4 "	16.00
21, "	No. 3, 4½ "	17.00
21, "	No. 4, 5 "	18.50
21, "	No. 5, 6 "	20.00
21, "	No. 6, 6¾ "	21.50

Dis., 60, 10 and 5%.

Ore Picks.

No.		
54, Adze Eye,	5 to 6 lbs	℔ doz. $12.00
54, "	6 to 7 "	" $13.00
54, "	7 to 8 "	" $14.00

56, Steel Lake Superior Mining Pick

(Special Price and Quality.)

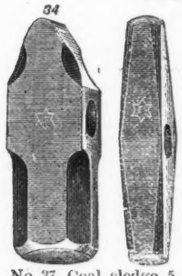
Dis, 60 and 10

Tamping Picks.

Adze eye, 6 to 7 lbs., per doz., $17.
Adze eye, 7 to 8 lbs., per doz., $18.
Adze eye, 8 o 9 lbs., per doz., $19.

Hunt eye, 6 to 7 lbs., per doz., $17.
Hunt eye, 7 to 8 lbs., per doz., $18.
Hunt eye, 8 to 9 lbs., per doz., $19.
Dis., 60 and 10%.

Steel Face Sledges.



No. 34. Smiths' sledges, 6 to 30 lbs., steel face, 17c. per lb.
No. 35. Stone sledges, 6 to 30 lbs., steel face, 17c. per lb.
No. 36. Striking sledges, 6 to 30 lbs., steel face, 17c. per lb.
No. 37. Coal sledges, 5 to 10 lbs., steel face, 18c. per lb.

Cast Steel Sledges.

No. 34. Blacksmiths' sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.
No. 35. Stone sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.
No. 36. Striking sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.
No. 37. Coal sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.

No. 43, hand drilling hammer, 5 lbs. and over, 36c.; 3 to 5 lbs., 40c.; under 3 lbs., 45c. per lb.
Dis., 70 and 10%.

Steel Face Hammers.

No. 43, hand drilling hammers, 2 to 5 lbs.; No. 45, napping hammers, 2 to 5 lbs.; No. 39, mason hammers, 3 to 8 lbs.; No. 42, smiths' hand hammers, 2 to 5 lbs.; No. 44, smiths' striking hammers, 2 to 5 lbs., all steel face, per lb., 26c.
Dis., 70 and 10%.

Cast Steel.

No. 42, blacksmiths' hand hammer, 5 lbs. and over, 30c.; 3 to 5 lbs., 34c.; under 3 lbs., 45c. per lb.
No. 44, drilling or striking hammer, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.
No. 45, napping hammer, 5 lbs. and over, 30c.; 3 to 5 lbs., 35c., under 3 lbs., 45c. per lb.
Dis., 70 and 10%.

RAILROADS.

Railway Track Punch

Round Point.
15c. lb., net.

Track Wrench.

7¾c. lb., net.

Rail Fork.

9c. lb., net.

Crow Bars.

Wedge Points, 3½c. lb., net.
Pinch Point, 3 ½c. lb., net.

65 Tamping Bar.

6c. lb., net.

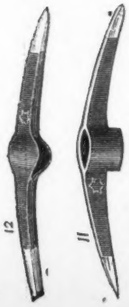
66 Claw Bar,

7c. lb., net.

Railroad Spike Mauls, 6 to 16 lbs., Steel Face 18c. lb.
Dis., 50, 10, and 5%.

Steel Track Chisel,
15c. per lb., net.

Railroad or Clay Picks.



No.				Per doz.
11,	Adze eye,	4 to	5 lbs	$11.00
11,	"	5 to	6 "	12.00
11,	"	6 to	7 "	13.00
11,	"	7 to	8 "	14.00
11,	"	8 to	9 "	16.00
11,	"	9 to	10 "	18.00
12,	Hunt eye,	4 to	5 "	11.00
12,	"	5 to	6 "	12.00
12,	"	6 to	7 "	13.00
12,	"	7 to	8 "	14.00

Dis., 60 and 10%.

Mattocks—Price per doz.

2, Adze Eye, Long Cutter, 6 lbs., $16.00.
3, Adze Eye, Short Cutter, 5½ lbs., $15.50.
2, Adze Eye, Long Cutter, Light, $15.00.
3, Adze Eye, Short Cutter, Light, $15.00.
4, Hunt Eye, Long Cutter, 6 lbs., $16.00.
5, Hunt Eye, Short Cutter, 5½ lbs., $15.50.

Adze Eye Pick Mattocks.....$16.

Hunt Eye Pick Mattocks.....$16

Dis., 60 and 10%.

Grub Hoes.

Western Pattern, No. 0, 3 lbs., ₱ doz., $10.50.
Western Pattern, No. 1, 3½ lbs., ₱ doz., $11.
Western Pattern, No. 2, 4 lbs., ₱ doz., $11.50.
Western Pattern, No. 3, 4½ lbs., ₱ doz., $12.
Baltimore Pattern, No. 1, 3½ lbs., ₱ doz., $11.
Baltimore Pattern, No. 2, 4½ lbs., ₱ doz., $11.75
Baltimore Pattern, No. 3, 5 lbs., ₱ doz., $12.75.
Baltimore Pattern, No. 4, 5¾ lbs., ₱ doz., $13.75.
Dis., 60 and 10%.

Shovels. C. S., long handle, round point.

Ames'.	Hobart's	Day's.
No. 1.... 11.50	8.00	8.00
2.... 11.50	8.00	8.00
3.... 12.25	8.50	8.50

D. Handles round point.

2....12.00	8.50	8.50
3....12.50	9.00	9.00

Dis., 20, 10 and 5%.

BOSTON PATTERN.

Trucks.

New York Pattern.

Size.	Length of handles. Ft.	In.	Width at nose. Inches.	Width at upper bar. Inches.	Size of wheel. Inches.	Price.
No. 0	3	6½	12	13¼	6½ × 1¾	$4.50
No. 1	4	1	13⅜	15⅜	6½ × 1¾	4.85
No. 2	4	5	15	16½	7¾ × 1⅞	6.00
No. 3	4	8	16	17¾	8¾ × 2¼	7.00
No. 4	5	0	16¼	17¾	9¾ × 2¼	8.00
No. 5	5	4	17¼	18¾	10¾ × 2¾	9.50

Discount 50%.
Special net prices on quantity orders.

BULLOCK'S PAT.

Tuyeres.

No. 2.	No. 4.
$25.00	$35.00 per doz.

20 % dis.

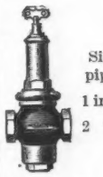
Valves.

Brass Globe and Angle Valves.

Size, inches.....	⅛	¼	⅜	½	¾	1
Star globe and angle valves.....$0.80	$0.85	$0.90	$1.20	$1.55	$2.00	
Star globe and angle valves, heavy patterns.....	...	...	1.50	1.95	2.80	
Extra heavy Star and Lion patterns. ...	...	...	2.00	2.60	3.60	
All brass, yoke top. ...	...	...	....	....	3.75	
Cross valves..... ...	1.15	1.25	1.50	2.00	2.50	
Star check valves.. .70	.70	.75	.95	1.20	1.65	
do. heavy pattern. ..	...	...	1.15	1.50	2.00	
Crescent globe and angle valves..... .60	.60	.75	1.00	1.35	1.80	
Crescent hose valves ..	...	...	...	...	...	
check valves. .	.50	.60	.85	1.15	1.55	
Vertical check v'lv's .	.50	.60	.85	1.15	1.55	
Jenkins globe and angle valves	1.10	1.25	1.60	2.20	2.80	
Jenkins check valv's .	1.10	1.20	1.30	1.90	2.60	
Gate valves, Chapman..... ..	...	...	1.30	1.75	2.25	
Gate valves, other makes..... ..	...	1.00	1.20	1.75	2.50	
Brass safety valves. ..	2.00	2.25	2.75	3.50	5.00	
Brass butterfly v'lv's ..	...	...	...	...	3.50	

Size, inches.....	1¼	1½	2	2½	3
Star globe and angle valves.	$3.00	$4.00	$6.50	$12.50	$19.00
do. heavy pattern.	3.95	5.30	8.35	14.00	22.00
Extra heavy Star and Lion patterns.....	5.40	7.20	10.80	18.20	28.60
All brass, yoke top.....	5.00	7.00	10.00	18.00	30.00
Cross valves.....	3.50	5.00	8.00	16.00	24.00
Star check valves.....	2.50	3.25	5.00	11.00	15.00
do heavy pattern..	3.00	4.00	6.50	12.50	17.00
Crescent globe and angle valves.....	2.80	3.90	5.90	11.25	16.00
Crescent hose valves.....	4.00	5.50	7.00	10.00	.....
" check valves.....	2.30	3.25	5.20	10.00	14.00
Vertical check valves..	2.30	3.25	5.20	10.00	14.00
Jenkins globe and angle valves.....	4.00	5.50	8.00	15.75	22.00
Jenkins check valves	3.60	5.00	7.50	13.50	20.50
Gate valves, Chapman.....	3.25	4.25	6.25	11.50	16.00
" " other makes....	3.50	5.00	7.50	15.00	22.00
Brass safety valves	7 00	8.50	12.00	20.00	30.00
Brass butterfly valves.....	4.50	5.50	8.00	11.00	16.00

Pressure Regulating.



Mason Regulator Co.

Size pipe.	Price.	Size pipe.	Price.	Size pipe.	Price.
1 inch,	$22.	1¼ inch,	$28.	1½ inch,	$35.
2 "	44.	2½ "	57.	3 "	72.

Ludlow Valve Co.
Double Gate Brass Valves.
Gland in packing box.

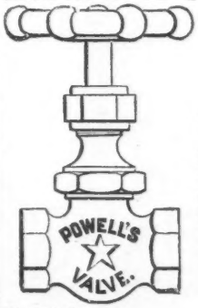
Size.	Screw socket.	Flange.	Diameter of Standard Flange.	Face to face of Screw socket	Face to face of Flanges.	Extra for slide stem and lever subject to discount.
In.	$	$	In.	In.	In.	
½	1.25	.....	.....	2¼	.....	$1.00
¾	1.65	.....	.....	2½	.....	1.00
1	2.15	.....	.....	2¾	.....	1.00
1¼	3.15	.....	.....	3⅛	.....	1.00
1½	4.25	.....	.....	3½	.....	1.00
2	6.25	11.50	6	4⅛	4⅝	1.00
2½	11.50	18.00	6½	4 13-16	5⅛	1.25
3	16.00	22.00	7	5	6¼	1.25
3½	21.00	31.00	7½	.....	.....	1.25
4	35.00	43.00	9	.....	7 1-16	1.25
5	52.00	64.00	10	.....	.....	1.25
6	78.00	90.00	11	.....	9	1.25
8	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....
12	.....	.....	.....	.....	.....	.....

Rubber-Faced Slide Gate Fire Hydrant.
See cuts on pages 19 and 20.

Diameter of pipe connection.	Diameter of stand pipe.	Diameter of seat ring.	One 2½ nozzle.	Two 2½ nozzles.	Three 2½ nozzles.
Inches.	Inches.	Inches.			
3 or 4	4⅝	3	$28		
3-4-6	5¾	4	31	$33.00	$35.00
4 or 6	7	5	.....	38.50	40.50
6 or 8	8	6	.....	49.00	51.00
8 or 10	10	8	.....	.....	.....

Four 2½ nozzles.	Six 2½ nozzles	One steamer nozzle.	One steamer and one 2½ nozzle.	One steamer and two 2½ nozzles.	Frost case, standard length.
.....	.....	$33.00	$35.00	$37.00	$4.50
.....	.....	38.50	40 50	42.50	5.00
$53.00	.....	49.00	51.00	53.00	6.50
.....	.....	.....	.....	.....	7.50

For each 6 inches more or less than standard length of stand pipe, add or deduct from list.	For each 6 inches more or less than standard length of frost case, add or deduct from list.	Extra charge for hub.	Independent nozzle gates each.
$0.60	$0.44	.....	.....
.75	.50	6 in. $0.50	$3.50
.85	70	No charge	3.75
1.00	.90	8 in. $1.25	3.75
.....	.....	.....	4.50



Star Radiator Valves, with Brass T Handles or Wood Wheels.

Size, inches.....	½	¾	1
Plain brass $1.60	$2.00	$2.50	
Plated trim'gs. 1.80	2.25	2.80	
Rough & Plat'd 2.00	2.45	3.05	
Finish'd & P'l't. 2.50	3.00	3.65	

Size, inches....	1¼	1½	2
Plain brass.....$3.60	$4.80	$7.50	
Plated trim'gs. 3.95	5.20	8.00	
Rough & Plat'd 4.20	5.50	8.50	
Finish'd & P'l't. 4.95	6.50	9.75	

Dis. 40, 10 and 5%.

Varnish.

Edward Smith & Co.

For Finishing Coats.	gal.
Wearing body varnish	$5.50
Medium drying body.....	5.50
One coat coach varnish.....	4.50
Wearing carriage.....	4.50
Heavy gear varnish.....	4.00
Coach body "	4.05
No. 1 coach "	2.20

For Under Coats.

Hard drying body.....$4.50		Black rubbing varnish.	$4.00
Rubbing body varnish.	4.00	Priming (1st coat).....	2.50
Quick rubbing "	3.50	Filling (2d coat).....	2.50
		Rough stuff.....	2.50

For Inside Work.

Best flowing varnish..$4.50		Hard oil finish light...	$2.75
Best polishing " ..	4.50	" dark...	2.25
Cabinet " ..	3.00	White copal.....	4.00

Dryers.

Japan gold size.....$3.50		Brown japan.....	$1.25
Coach japan.....	1.75	Liquid dryer.....	1.25

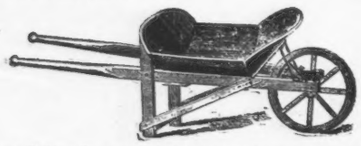
Discount, 40 per cent. f.o.b. N. Y.

Preservative Coatings.

Spar coatings.....$4.00		Exterior car coating..	$4.00
I. X. L. No. 1.....	2.50	Interior car coating...	3.25
I. X. L. No. 2.....	4.00	Locomotive coating....	4.00
Floor finish.....	2.50		

Discount, 35 per cent, f.o.b. N. Y.

Wheelbarrows.



Climax Bolted Barrow, with Wood Wheel per doz. $22.50.
1½ tire of iron.
Common Nailed Barrow per doz. $18.50.
" Bolted " " " 18.75.
Lansing's Patent Iron-Bolted Barrow, per doz., $25.50
Capital Patent Bolted Dirt " " " 30.00
Red oak or Government " " " 40.50
Wharf " " " 72.50
Mortar " " " 30.00
Bent Handle Stone " " " 48.00
Coal or Ore " " " 31.50
Pig Metal or Casting " " " 40.50
Brick Yard 20 inch Iron Wheel " each 10.50
Globe Patent Bolted Garden Barrow } per doz., 42.50.
Box 30 by 24 by 12 deep, wood wheel }
Capital Patent Barrows
With Iron Tray, A, per doz., ...$39.00
" " " B, " 42.00
The Leader Iron and Steel Barrows.
Gas-pipe Legs and Handles in one price.
No. 1 Tray of 16 iron, capacity 3 cu. ft. of earth, each $12.
No. 2 " " 14 " " 5 " " "
or 250 lbs. of coal..... " 15
3 Galvanized 18 iron, capacity same as No. 2..... " 15

Whiffletree.

Willson spring (Jeffery Manufacturing Company).

	Single.	Double.
No. 1, 34 or 36 inches long	$1.25	$2.50
No. 2, " " "	1.40	2.75
No. 3, " " "	1.50	3.00
No. 4, " " "	1.65	3.25

Including either steel hooks or rings
Discount, 45 and 5%.

Wick.

Baltimore Twine & Net Co.
Braided, all kinds, from..... ..... 60c. to $1.00

LAMP.

0, or E.....per gross..$0 40
1, or A..... " .60
2, or B..... " .75
3, or D..... " 1.30
Brilliant, Argand and Crystal light..... " 1.60
Deitz..... " .70
B—Double Thick..... " 2.00
Pet Circular..... " .33
German Pet..... " .55
Moehring..... " 3.00
Mann's Monarch..... " 2.00
Dual..... " 2.00
Duplex and Oxford..... " 3.00
Wide Awake and Nutmeg..... " .40
Tom Thumb, Round and Flat..... " .25
Nos. 1 and 2 German Student..... " 1.10
BB, or Bonanza..... " 2.00
AA..... " 1.50
Above, in 32-yard pieces.....as per gross
Round Fluid.....per doz..$ .30
Wick in Boxes.....3 cents extra
Dis., 60, 10, 5 and 3%.

CANDLE.

13 to 20 cents.

Wind Mills.

10 ft. pumping.... $75
12 ft. " 95
14 ft. " 140
16 ft. " ... 225
} Plus cost of packing.
Dis., 50 per cent.

Wire Cloth.

Newark, O., Wire Cloth Co.
Brass and Copper Wire Cloth.

No. Mesh.			Price per foot.	No. Mesh.			Price per foot.
2 from No.	10	wire	$2 50	20 from No.	26	wire	$ .80
3 "	11	"	2.50	22 "	27	"	.80
4 "	12	"	2.50	24 "	28	"	.80
5 "	13	"	2.50	30 "	30	"	.65
6 "	14	"	2.50	40 "	32	"	.70
8 "	16	"	2.00	50 "	34	"	.75
10 "	18	"	2.00	60 "	35	"	.78
12 "	19	"	2.00	70 "	37	"	.70
14 "	22	"	1.10	80 "	38	"	.90
16 "	24	"	.80	90 "	39	"	1.10
18 "	25	"	.80	Dis., 60%.			

Wire Goods.

Fly Traps. Per gross.
Paragon.....$18.00
Balloon..... 15.00

Woodenware. MALLETS.

Round Hickory.

	Per doz.	Barrels contain about.
No. 1, 2 to 2½ in.	$1.25	10 dozen.
" 2, 2½ to 3 "	1.75	8 "
" 3, 3 to 3½ "	2.25	5 "
" 4, 4 "	2.50	4 "

Round Lignumvitæ.

	Per doz.	Barrels contain about.
No. 1, 3 inches...	$3.00	6 dozen.
" 2, 3½ " ...	4.00	5 "
" 3, 4 " ...	5.00	4 "
" 4, 5 " ...	6.00	3 "

ROLLING PINS.

Packed in crates of one gross, and in boxes of one dozen. Solid and Loose or Revolving handles. Per dozen, $1.00.

SHOVELS.
Grain Scoops or Shovels (Wood).

Small size, price per dozen, $7.
Medium size, price per dozen, $8.
Large size, price per dozen, $9.
Made out of selected Hardwood, Maple, Beach and Birch.
Small, Medium and Large Sizes; used for Grain, Malt, Potatoes, Fruit, etc.
Long Handle Scoops, 4 feet long, $12 per dozen.

MASHERS.
Beefsteak.

Price, 70c. per dozen; barrels contain about 12 dozen.
Made out of Sugar Maple.

Potato.

Small size, 50c. per dozen; barrels contain about 30 dozen.
Medium size, 60c. per dozen; barrels contain about 15 dozen.
Large size, 70c. per dozen; barrels contain about 11 dozen.
Made out of Hard Sugar Maple and Wax Polished.

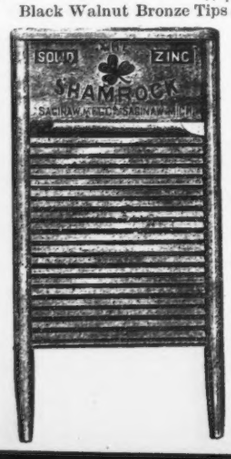
Wringers and Washing Supplies.

Royal Keystone cog wheel, 10 by 1¾ rolls, $36 per doz.
No. 10, wood frame cog wheel, 10 by 1¾ rolls, $24.50.
No. 16, wood frame cog wheel, 11 by 1¾ rolls, $29.
No. 18, wood frame cog wheel, 11 by 1⅞ rolls, $33.50.
No. 20, wood frame cog wheel, 11 by 2 rolls, $39.50.
No. 22, wood frame cog wheel, 12 by 1⅞ rolls $39.50.
No. 24, wood frame cog wheel, 12 by 2 rolls, $48.50.
No. 11, iron frame cog wheel, 10 by 1⅝ rolls, $20.
No. 2, iron frame cog wheel, 10 by 1¾ rolls, $24.
Solance iron frame (Eureka Pat.), 10 by 1¾ rolls, $20.
Solance iron frame (Eureka Pat.), 11 by 1¾ rolls, $24.50
F.o.b. cars at works; 60 cents doz extra f.o.b. New York.
Keystone Double Bench Wringer.
Rolls, 10 by 1¾, $36.50 per doz.
Made to fold.
Folding Double Folding Wash Bench, packed 6 in crate per doz., $14.
Adams Ironing Table, per doz.....$15.00
Keystone Washing Machines, per doz..... 24.00
Complete " " " 13.50
People's " " " 13.50
Lovell " " " 13.50

Net prices.
Cabinet Clothes Driers, per doz., $21.00 net,
Excelsior Clothes Horse, per doz., $6.00 net.
Reversible Clothes Horse.

	High.	Per doz.	
A	3 ft.,	$14.00	Dis., ash, 50 and 10%.
B	3 ft. 10 in.	16.00	
C	4 ft. 10 in.	18.00	
D	5 ft. 10 in.	20.00	Basswood, 60 and 10%.

Nursery Reversible Clothes Horse.
2 section, 3 ft. high, per doz.....$9.00
3 " " " 12.00
4 " " " 16.00
Black Walnut Bronze Tips and Hinges. Dis., 30%.



WASHBOARDS.

Saginaw Mfg. Co.

The following prices are on orders of not less than 25 dozen of one kind, or an assortment.

Wilson, one rubbing surface, per doz., $1.40.
Saginaw, one rubbing surface, per doz., $1.25.
Exchange, one rubbing surface, per doz., $1.10.
Wilson, two rubbing surface, per doz., $2.
Saginaw, one rubbing surface, per doz., $1.75.
Crescent, one rubbing surface, per doz., $2.25.
Shamrock, one rubbing surface, per doz., $2.

Rubbing surface of the two latter is solid sheet of zinc, without wood backs.

TABLE CONVERTING AMERICAN INTO ENGLISH MONEY.

American cents	1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90	100
English money	d. ½	d. 1	d. 1½	d. 2	d. 2½	d. 3	d. 3½	d. 4	d. 4½	d. 5	d. 9½	d. 9	d. 10½	d. 11½	s. d. 1	s. d. 1 1½	s. d. 1 3	s. d. 1 4½	s. d. 1 6
American cents	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
English money	s. d. 1 5	s. d. 1 5½	s. d. 1 6	s. d. 1 6½	s. d. 1 7	s. d. 1 7½	s. d. 1 8	s. d. 1 8½	s. d. 1 9	s. d. 1 9½	s. d. 1 10	s. d. 1 10½	s. d. 1 11	s. d. 1 11½	s. d. 2	s. d. 2 ½	s. d. 2 1	s. d. 2 1½	s. d. 2 2
American cents	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
English money	s. d. 2 9½	s. d. 2 10	s. d. 2 10½	s. d. 2 11	s. d. 2 11½	s. d. 3	s. d. 3 ½	s. d. 3 1	s. d. 3 1½	s. d. 3 2	s. d. 3 2½	s. d. 3 3	s. d. 3 3½	s. d. 3 4	s. d. 3 4½	s. d. 3 5	s. d. 3 5½	s. d. 3 6	s. d. 3 6½
American dollars	1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90	100
English £ s. d.	£0 4 2	£0 8 4	£0 12 6	£0 16 8	£1 0 10	£1 5 0	£1 9 2	£1 13 4	£1 17 6	£2 1 8	£4 3 4	£6 5 0	£8 6 8	£10 8 4	£12 10 0	£14 11 8	£16 13 4	£18 15 0	£20 16 8

EXAMPLE.—If you want to convert $94.62, table shows that $90 equals £18 15s.; $4 equals 16s. 8d.; 62 cents equals 2s. 7d.; total, £19 14s. 3d.

NEW YORK PRICES CURRENT.
JUNE 1, 1889.

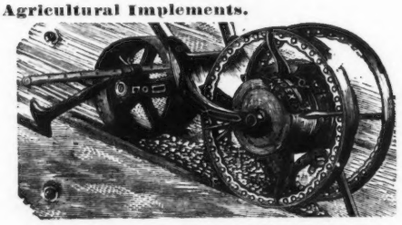
Discounts are for Export Only.

In the interest of the extension of the markets for American manufactures the ENGINEERING AND MINING JOURNAL has secured the services of gentlemen thoroughly acquainted with the export trade and with foreign markets, and it offers its services to foreign buyers who may desire information concerning any article whatever of American manufacture. No charge will be made for these services, either directly or indirectly through commissions on goods purchased. The proprietors of the ENGINEERING AND MINING JOURNAL are neither commission merchants nor exporters, but they have many sources of information, both at home and in foreign countries, and place these at the service of manufacturers and exporters here and of importers and consumers in other countries.

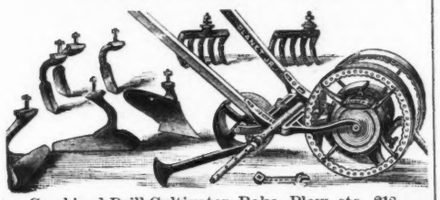
N. B.—Special attention is invited to the goods advertised and illustrated in the advertising pages of the ENGINEERING AND MINING JOURNAL.

Price lists and other information may be obtained by addressing the advertisers direct or by writing to the ENGINEERING AND MINING JOURNAL.

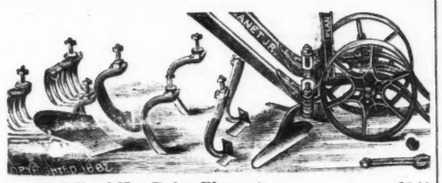
Agricultural Implements.



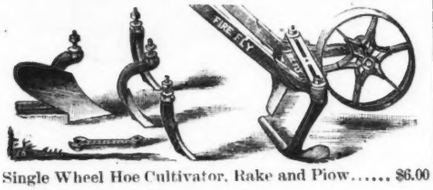
"Planet, Jr." No. 2 Seed Drill, $9.



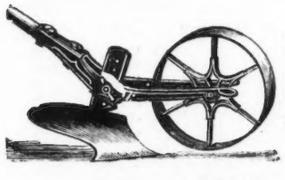
Combined Drill Cultivator, Rake, Plow, etc., $12.



Double-Wheel Hoe Rake, Plow, etc..... $8.00
Double-Wheel Hoe, plain (Hoe's only)..... 4.50



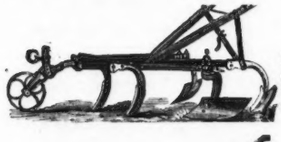
Single Wheel Hoe Cultivator, Rake and Plow..... $6.00



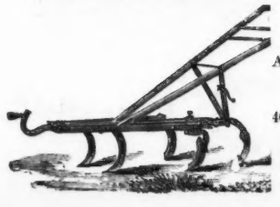
"Fire Fly" single-wheel Hoe, Cultivator and Plow, $5.

"Fire Fly" Hand Plow, $2.50.

30 % discount, f.o.b. New York.



All Steel Horse Hoe and Cultivator combined, with wheel, $11.



All Steel Plain Cultivator, $6.00.

40% discount, f.o.b., New York.

HAY FORKS.

Ely Hoe & Fork Co.—Gold Finish, Patent Overcaps.

Three Tine Forks.

No.	Tine.	Handles.		Per doz.
30	10 in.	4½ ft.	Boy's	$7.75
32	12 "	4 to 6 ft.		9.00
32 S	12 "	"	Strapped	10.50
32 B	12 "	"	Bent	9.50
32 B S	12 "	"	Bent & St'pd	11.00
33	12 "	"		9.50
33 S	13 "	"	Strapped	11.00
33 B	13 "	"	Bent	10 00
33 B S	13 "	"	Bent & St'pd	11.50
34	14 "	"		10.25
34 B	14 "	"	Bent	10.75
35	15 "	"		11.25
35 B	15 "	"	Bent	11.75
42 B	12 "	"	Bent	12.50
42 B S	12 "	"	Bent & St'pd	14.00

Manure Forks, Solid Steel Shanks, Gold Bronze Finish, Patent Overcaps.

No. 44, oval, 4 tine, 12 in. tine, 4 ft. handle, plain ferrules, $12.50 per doz.

No. 44 S, oval, 4 tine, 12 in. tine, 4 ft. handle, strapped ferrules, $14.

No. 44½, oval, 4 tine, 12 in. tine, 4½ ft. handle, plain ferrules, $12.50.

No. 44½ S, oval, 4 tine, 12 ft. tine, 4½ ft. handle, strapped ferrules, $14.

No. 54, oval, 5 tine, 13 in. tine, 4 ft. handle, plain ferrules, $19.50.

No. 54 S, oval, 5 tine, 13 in. tine, 4 ft. handle, strapped ferrules, $21.

No 64, oval, 6 tine, 13 in. tine, 4. ft. handle, plain ferrules, $22.50.

No. 64 S, oval, 6 tine 13 in. tine, 4 ft. handle, strapped ferrules, $24.

HOES.

Ely Standard Socket, all Gold Bronze Neck, full Pol'd, C. S. Blade.

Field, 7	× 5	in.,	selected handles	$9.00
" 7½	× 4½	"	" "	9.00
" 8	× 4¾	"	" "	9.00
" 8½	× 4½	"	" "	9.00
" 8	× 5	"	" "	9.00

Washington County Pattern, spring handles..... 10.00
Rhode Island, 7 to 9 in., spr'g handles 9.00
" " 9½ in. " " 9.25
" " 10 " " " 9.50

Meadow, 9 × 4 in., poplar handles..... 9.00
Meadow, 9½ × 3½ in., poplar handles..... 9.25
Meadow, 10 × 3½ in., poplar handles..... 9.50
Broom Corn, 7½ × 4½ in., poplar handles..... 9.00

Popular Handles in Meadow Socket Hoes, unless otherwise ordered.

PLOWS.

Reversible Oneonta Clipper.

16. Oneonta Clipper, Reversible, Iron beam Cutter..... $14
" Oneonta Clipper, Reversible, Iron Wheel and Cutter..... 15
18. Oneonta Clipper, Reversible, Iron Beam Cutter..... 15
" Oneonta Clipper, Reversible, Iron Beam, Wheel and Cutter..... 16
17. Hard Metal, Reversible, Iron Beam Cutter..... 17
17. Hard Metal, Reversible, Iron Beam, Wheel and Jointer..... 17
19. Hard Metal, Reversible, Wood Beam Cutter..... 16
" " " " " Wheel and Jointer..... 17
20. Steel Mould Board, Reversible, Wood Beam Cutter 15
" " " " " " Wheel and Cutter..... 16

Iron Beam Plows.

Two-horse Sod and Stony Land.... 8.50 plain.
Curtis's Sod Two horse..... 11.50
" " " " ..... 13.00 cutter.
" " " " ..... 14.25 wheel & cutter.

Subsoil Plows.

Two-horse 9.50 Draft Rod.
" " 11.00 Wheel and Draft Rod.

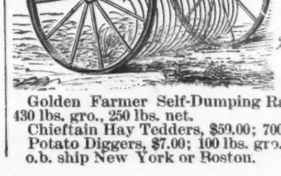
Hitchcock's Potato Digger and Shovel Plow.

Improved adjustable handle shovel plow..... 7.00
Hitchcock's Potato Digger..... 8.00
" " " and shovel plow..... 10.50
Dis. 30%.

RAKES.

The S. R. Nye Improved.

22 Teeth Rake, $32.00
26 " " 34.00
25% dis.



Chieftain Lock Lever
No. 1..... $30.00
No. 2..... 30.00
No. 5..... 29.00
Iron wheels, $2 extra.
With Pole, Double Tree and Neck Yoke, $2 extra.
22 cubic feet packed, 400 lbs. gro.; 225 lbs. net.

Golden Farmer Self-Dumping Rake, $37.00; 22 cu. ft., 430 lbs. gro., 250 lbs. net.
Chieftain Hay Tedders, $59.00; 700 lbs. gro., 450 lbs. net.
Potato Diggers, $7.00; 100 lbs. gro., 60 lbs. net; dis., 40% o.b. ship New York or Boston.

RAKES (GARDEN).

Braced steel garden rakes. Per doz.

8 teeth		$8.00
10 "		9.00
12 "		10.00
14 "		11.00
16 "		12.00

Braced malleable garden rakes.

10 teeth		$5.50
12 "		6.00
14 "		6.50
16 "		7.00

Smith-Harper Riveted Garden Rakes, Wood Heads.

No.	Wrought teeth.	Per doz.
8-teeth rakes, wrought, 6 feet handles		$5.00
10 "	" "	5.50
12 "	" "	6.25
14 "	" "	7.00

Best Polished Cast Steel Rakes.

No.	Handles.	Per doz.	No.	Handles.	Per doz.
1—16	teeth, 6 feet	$12.00	4—10	teeth, 6 feet	$9.00
2—14	" 6 "	11.00	5—8	" 6 "	8.00
3—12	" 6 "	10.00	6—6	" 5½ "	6.00

Lawn or gravel rakes, price same cast steel garden rakes
Tar rakes, 14 teeth, 18 inch, iron shank, 4½ feet handles, net..... $12.00

No.	Malleable Iron Garden Rakes.	Per doz.
8—8	teeth, polished, 5½ ft. handles	$5.00
10—10	" " 6 "	5.50
12—12	" " 6 "	6.00
14—14	" " 6 "	6.50
16—16	" " 6 "	7.00

10 doz. case lots, 60, 10 and 5% cased.

Geneva Tool Co.

Ten-Teeth	Malleable Garden. Plain.	Braced.	Steel Garden. Plain.	Braced.
10-Teeth	$5.50	$6.00	$9.00	$10.50
12 "	6.00	6.50	10.00	11.50
14 "	6.50	7.00	11.00	12.50
16 "	7.00	7.50	12.00	13.50

Dis. 70 and 5%.

Cast steel garden rakes.

	Per doz.
10 teeth, polished, tapering bar, tempered rake	$9.00
12 " " " " " "	10.00
14 " " " " " "	11.00
16 " " " " " "	12.00

Cast steel lawn rakes.

12 teeth, polished, tapering bar, tempered rake	$10.00
14 teeth polished tapering bar, tempered rake	11.00
16 teeth polished tapering bar, tempered rake	12.00
18 teeth polished tapering bar, tempered rake	13.00

Dis. 70% from Standard Association list.
Prices made where XX handles, etc., are required.

SCYTHES (GRASS).

Waldron's pattern, oiled	$8.50
Silver steel, painted	8.50
Western dutchman, bronzed and painted	9.00
Clipper, polished web	9.00
Fine cutlery steel, full polished	10.00
All steel, full polished	11.00
Grain Scythes.	
Waldron's pattern, oiled	11.25
Silver steel, painted	11.25
Clover, oiled	11.25
Clipper, bronzed and painted	11.50
Lawn Scythes.	
Clipper, bronzed and painted	9.00

Dis., 40 and 10%.

SOWER, BROADCAST SEED.

Per dozen..... $36 f.o.b.

Gross wt., 110 pounds per dozen

Net wt., 75 pounds per dozen.

Apple Parers.

Little Gem.

	Per doz.
Advance	$4.75
Baldwin	5.25
Champion	7.25
Hudson's '88	3.75
Improved Bay State	30.
Monarch	31.50
Oriole	4.00
Turntable	4.50
Victor	13.50
White Mountain	4.50
Rocking Table	4.25
Little Gem Corer and Slicer	3.70

Rocking Table.

Anvils.

"Eagle anvils."

	Weight about			Weight about	
No. 000	½ lb.	$1 00	No. 4	40 lbs.	$4.25
" 00	4 "	1.70	" 5	50 "	5.05
" 0	10 "	2.20	" 6	60 "	5.50
" 1	15 "	2.75	" 7	70 "	6.00
" 2	20 "	3.00	" 8	80 "	7.00
" 3	30 "	3.75	" 9	90 "	8.00

Anvils weighing 100 to 800 lbs., 10 cts. per lb. Discount 20 and 10 %.

Arms and Ammunition.

Wood Powder.
American Wood Powder Company.
¼ kegs.

	Kegs, 25 lbs.	6¼ lbs.	1 lb. cans.
Trap for first quality arms only	$19.50	5.00	.85
A, for large bore. C, for general use.. D, fine for small bore and rifles. E, very fine for small bore rifles and gallery shooting	17.00	4.35	.75

Hartley & Graham,
Union Metallic Cartridge.

	Discount. Per cent.	
Bullet Breech Caps, per lb.	1.60	10
Conical Bullet Caps "	1.75	10
Rim Fire Cartridges	60	10
Military Rim Fire Cartridges	15	10
Central Fire Pistol and Rifle Cartridges	40	10
Central Fire Metallic Cartridges for Target and Sporting Rifles	30	10
Military Cartridges, Central Fire	30	10
Lefaucheux Cartridges		60
Gatling Cartridges		Special
Primed Shells and Bullets	25	10
Friction Cannon Primers	20	10
Primers		10
Percussion Caps, F. C. per M.	33c.	
U. M. C. "	42½c.	
Musket "	45c.	
Brass Shot Shells, U. M. C., 1st qual.	60	10
Club brand	65	10

Paper Shot Shells.

14, 16 and 20 ga. First quality, 30, 10 and 10 per cent; 4, 8, 10 and 12 ga., First quality, 25, 10 and 10 per cent.
14, 16 and 20 ga. Club brand, 30, 10 and 10 per cent.
10 and 12 ga. Club brand, 33⅓, 10 and 10 per cent.
Gun Wads, 20 and 5 per cent.

REVOLVERS.

Smith & Weston

32, Single Action, 3, 3½ in., $8.00.
32, Double Action, 3, 3½ in., $9.35.
32, Safety Hammerless, 3, 3½ in., $11.00.
38, Single Action, 3¼ in., $9.40; 38, Single Action, 4 in., $9.65; 38, Single Action, 5 in., $10.00; 38, Double Action, 3¼ in., $10.40; 38, Double Action, 4 in., $10.65; 38, Double Action, 5 in., $11.00; 38, Safety Hammerless, 3¼ in., $12.00; 38, Safety Hammerless, 4 in., $12.25; 38, Safety Hammerless, 5 in., $12.50; 44, Single Action, 4 in., $11.50; 44, Single Action, 5 in., $11.75; 44, Single Action, 6, 6½ in., $12.00; 44, Double Action, 4 in., $12.50; 44, Double Action, 5 in., $12.75; 44, Double Action, 6½ in., $13.00; 44, Double Action Favorite, 5 in., $12.75.

Colts.

Discount, 10 per cent from following prices.

Double Action Army, 44 and 45 calibre, 4¾, 5½, 7½ inch bbl., $13.00.
Double Action, 41 calibre, 2½ to 6 inch bbl., $11.20.
" " " 38 " 2½ to 6 " " " $10.00.
Single " Army, 45 calibre, 4¾, 5½, and 7½ inch bbl., $12.00.
Single Action Army, 44 calibre, "Frontier," 4¾, 5½, and 7½ inch bbl., $12.00.
New Line, 41 calibre, blued or nickeled, $4.00.
" " 32 " " " 4.00.
" " 30 " " " 2.00.
" " 22 " half or full plate, 2.10.
Old Model, 22 calibre, by the hundred, half or full plate, $1.50.
Colt Deringer. 41 calibre, per pair half or full plate, $5.50.

American Bull Dog

Double Action 32, 38 and 44 calibre, 2½ inch barrel, $1.60; Double Action 32, 38 and 44 calibre, 4½ inch barrel, $1.85; Double Action 32, 38 and 44 calibre, 6 inch barrel, $2.10.

F. & W. English Bull Dog revolvers, 32 and 38 calibre 2½ inch bbl., $1.80.
F. & W. Automatic revolver, 32 and 38 calibre, 3¼ inch bbl., $5.50.
H. & R. Automatic revolver, 32 and 38 calibre, 3¼ inch bbl., $4.75.
Defender revolvers, Single Action, 22, wood handle, 65.
" " " " 22, rubber " 70.
" " " " 32, wood " 85.
" " " " 32, rubber " 90.

Remington Army revolver, Single Action, 44 cal., frontier cartridge, 5¾ inch barrel, $6.50.
Remington Army revolver, Single Action, 44 cal., frontier cartridge, 7½ inch barrel, $6.00.
Remington Double Deringers, 41 cal., rim fire, $4.05.
National Deringers, 41 calibre, per pair, half or full plate, $4.00.
New House, 41 or 38 calibre, blued or nickeled, $5.00.
" Police, 38 calibre, 6 in., " " 7.00.
" " 38 " 4½ in., " " 7.00.

RIFLES.

Colts' Lightning Magazine.

	Discount 10 per cent.	
40/60 and 45/60 calibre octagon barrel	10 lbs.	$15.38
" " " " round "	9¾ "	14.25
" " " " carbine "	9 "	14.25
32, 38, and 44 calibres, octagon "	7¼ "	13.50
" " " " round "	6¾ "	12.38
" " " " carbine "	6¼ "	12.38
" " " " baby carbine	5¼ "	12.38
22 calibre, rim fire, octagon barrel		15.38
" " " round		14.25

Remington Light (Baby) carbines, 44 cal., nick., $7 50.

Assay Furnace.

Hydro-Carbon Blow-Pipe Assay Furnace.

No. 2, Muffle Furnace taking C Battersea Muffle 8x4¾x3in. $10.00
No. 3, taking F Muffle, 10x6x4 in. 15.00
No. 1, Crucible Furnace, taking Battersea, U or Colorado B Crucible, 4 in. dia. 5½ deep. 4.00
No. 2, taking Battersea E, round, 5 in. dia., 6½ deep. 5.00
Blow-Pipe No. 1, with half gallon tank, made of plain, strong sheet metal. 18.00
Blow-Pipe No. 2, with half gallon tank, made entirely of seamless brass. 23.00
Blow-Pipe No. 3, with one gallon tank, otherwise same as No. 2. 26.00
Blow-Pipe No. 1, Muffle Furnace No. 2, and Crucible Furnace No. 1. 32.00
Blow-Pipe No. 2, Muffle Furnace No. 2, and Crucible Furnace No. 1. 37.00

Axes, etc.

Shingling Hatchets.

	1.	2.	3.	
Collins',	$4.75,	$5.25,	$5.75	doz., dis. 10%.
Peck's,	$8.00,	$8.50,	$9.00	doz. dis. 45%.
Ryder's,	$8.00,	$8.50.	$9.00	doz., dis. 50%.

Claw Hatchets.

	1.	2.	3.	
Collins',	$5.25,	$5.75,	$6.25	doz., dis. 10%.
Peck's,	$9.00,	$9.50	$10.00,	doz., dis 45%.
Ryder's,	$9.00,	$9.50,	$10.00	doz., dis. 10%

Hatchets, Broad Single Bevel.

Collins', cut in., 5, $9.50; 5½, $10.00; 6, $10.50; 6½, $11.00; 7½, $11.50; dis. 10%.
Peck's, cut in., 4, $10.50; 4½, $11.50; 5, $13.00; 5½, $14.50; 6, $16.50; 6½, $18.00; 7½, $19.50; 8¼, $22.00; dis. 45%.
Ryder's, cut in., 5, $13.00; 5½, $14.50; 6, $16.50; 6½, $18.00; 7½, $19.50; dis. 50%.

Adzes.

	House. Half flat head. Dozen.	Ship spur poll. Dozen.	Discount. Per cent.
Collins'	$14.00	$13.00	10
Peck's	24.00	25.00	45
Ryder's	24 00	25.00	50

Broad Axes—Pittsburgh Pattern.

5 to 8 pounds, $32.00 dozen.
7 to 9 pounds, $35.00 dozen.
8 to 10 pounds, $38.00 dozen.
9 to 12 pounds, $45.00 dozen.
Western pattern same price.

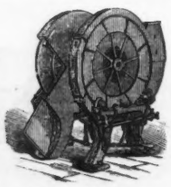
Spanish Pattern. Detumba round eye, $10.50 per doz.

Spanish Pattern Media labor, $12.25 per dozen.

Axle Grease.

Frazer's (2-lb. tins), per gross	$18.00
2-lb. wooden boxes, "	12.00
Discount, 25 and 5 %.	
Dixon's Everlasting, boxes 1 lb., per doz	$1.20
" " " 2 lbs., "	2.00

Barrel Machinery.



Stave Jointers.

Single Wheel Beer Keg Stave Jointer, 16 to 22 in.	8	8	$190
Double " " " " " 16 " 22 "	8	8	330
Single Wheel Half Barrel " " 24 " 30 "	8	8	275
Double " " " " " 24 " 30 "	8	8	440
Single " Barrel " " 30 " 36 "	8	8	330
Double " " " " 30 " 36 "	8	8	500
Double Independent Barrel Stave Jointer with Wheels, on separate shafts, but suspended in one frame, 30 to 36 in.	8	8	520
Single Wheel Barrel Stave Jointer, 32 to 38 in.	8	8	350
Double " " " " 32 to 38 "	8	8	550
Double Independent Barrel Stave Jointer, 32 to 38 in.	8	8	575

Bellows.

Miner's Bellows: 24 in., $8.50; 26 in., $9.75; 28 in., $11.00; 30 in., $11.25; 32 in., $13.50. 60 and 5% dis.
Standard, each: 18 to 24 in., $10; 28 in., $12; 32 in., $14; 34 in. $16; 36 in., $18; 38 in., $20; 40 in., $23; 44 in., $32. 60 and 5% dis.
Hand Bellows, per doz.: 6 in., plain, $10; fancy, $20; 7 in., plain, $12; fancy, $24; 8 in., plain, $14; fancy, $28; 9 in., plain, $16; fancy, $32; 10 in., plain, $18; fancy, $36. 50% dis.

Belting.

LEATHER BELTS.

Standard Manufacturers List.
Single belts per foot.

Width.		Width.		Width.	
1 inch	.10	6 inch	.76	20 inch	2.84
1¼ "	.13	7 "	.90	21 "	3.02
1½ "	.17	8 "	1.02	22 "	3.20
1¾ "	.20	9 "	1.15	23 "	3.37
2 "	.23	10 "	1.29	24 "	3.54
2¼ "	.26	11 "	1.42	26 "	3.92
2½ "	.30	12 "	1.55	28 "	4.30
2¾ "	.33	13 "	1.68	30 "	4.64
3 "	.36	14 "	1.82	32 "	5.00
3½ "	.43	15 "	1.98	34 "	5.35
4 "	.50	16 "	2.14	36 "	5.70
4½ "	.56	17 "	2.31	40 "	6.40
5 "	.63	18 "	2.49	44 "	7.10
5½ "	.70	19 "	2.66	48 "	7.80

Double belts twice the price of single.
Discounts of Newark Leather Belting Co.
Dis. single and double belts, cemented, 50 and 5%.
Dis. single and double belts, riveted and cemented, 50 and 5%.
Dis. single belts, cemented and lacesewn, water proofed, 50%.
Dis. double belts, cemented and lacesewn, water proofed, 45%.
Discounts of I. B. Williams & Sons.
Single and double belting, riveted .50 and 10 %.
" " " " cemented .50 and 10 %.
" " " " laced sewed .50 and 5 %.
Electric light belting, single and double cemented only, waterproof .50%.
2% cash f.o.b. New York.
Leather Belt Laces and Leather.
Discounts of I. B. Williams & Sons.

¼-inch per 100 feet	$1.00	⅛-inch per 100 feet	$2.00
5-16 " " " "	1.25	⅜ " " " "	2.75
⅜ " " " "	1.50	¾ " " " "	3.25

Dis., rawhide, 50 and 10%.
" taned, 60 and 10%.
Rawhide lace sides 19c. per square foot.
Tanned " " 14c. " " "

GASKETS.

Corrugated Copper.

Price, 2 cents per square inch, less 30 per cent. discount for home trade.

Less 60% discount for export trade.

Bolts.

Philadelphia Tire Bolt, with forged nuts.
Price per hundred.
Condensed list.

Length	1-8	3-16	7-32	1-4	5-16	3-8
1	$1·50	$1.50	$1.50	.....	.....	.....
2	1·50	1 60	1.85	$2.25	$3.05	$5.00
3	.....	1.90	2.25	2.75	3.65	5.80
4	.....	.....	.....	3.25	4.25	6.60
5	.....	.....	.....	.....	4.90	7.40

Fractional sizes, intermediate prices.
Discount 80 and 25 %.

Common Carriage Bolts, price per hundred.

Length.	3-16 & 1-4	5-16	3-8	7-16	1-2	9-16 & 5-8	3-4	
1 to 1½	.....	$1.35	$1.60	$2.30	$3.10	$3.80	$7.50	
2	.....	1.45	1.75	2.30	3.10	3.80	7.50	
3	.....	1.65	2.05	2.70	3.60	4.44	7.50	$13.50
4	.....	1.85	2.35	3.10	4.10	5.08	8.50	14.90
5	.....	2.05	2.65	3.50	4.60	5.72	9.50	16.30
6	.....	2.25	2.95	3.90	5.10	6.36	10.50	17.70
7	.....	2.45	3.25	4.30	5.60	7.00	11.50	19.10
8	.....	2.65	3.55	4.70	6.10	7.64	12.50	20.50
9	.....	2.85	3.85	5.10	6.60	8.28	13.50	21.90
10	.....	3.05	4.15	5.50	7.10	8.92	14.50	23.30
12	.....	3.45	4.75	6.30	8.10	10.20	16.50	26.10
14	.....	3.85	5.35	7.10	9.10	11.48	18.50	28.90
16	.....	4.25	5.95	7.90	10.10	12.76	20.50	31.70

Fractional sizes, intermediate prices.
Discount 75 and 10%

Philadelphia Carriage Bolt, price per hundred.

Length	1-8, 3-16 & 1-4	5-16	3-8	7-16	1-2
1 inch.	$3.00	$4.00	$5.00	$7.40	$9.00
2 "	3.40	4.10	5.00	7.40	9.00
3 "	3.80	4.70	5.80	8.20	10.00
4 "	4.20	5.30	6.60	9.00	11.00
5 "	4.80	6.00	7.40	9.80	12.00
6 "	5.40	6.60	8.20	10.60	13.00
7 "	.....	7.30	9.00	11.40	14.00
8 "	.....	7.90	9.80	12.20	15.00
9 "	.....	8.50	10.60	13.00	16.00
10 "	.....	.....	11.40	13.80	17.00
11 "	.....	.....	.....	14.60	18.00

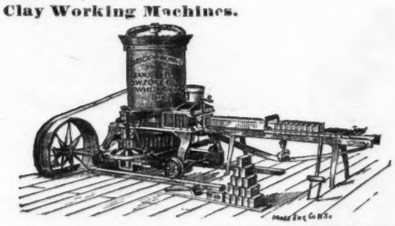
Fractional sizes, intermediate prices.
Discount 80 and 5 %.

Can Openers.

	Gross.		Doz.	
American	$3.00	Eureka	$2.50	10 % dis.
Duplex	2.70	20 % dis.	Domestic	2.50	45 % dis.

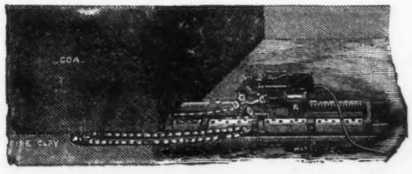
Cigarettes (all tobacco).
Liberty Bell (small cigars) ..... $6.00 per 1000
Golden Giants (regular shape) ..... 7.00 " "
Net f. o. b., New York.

Clay Working Machines.



	No. brick per day.	Compl'te.
No. 10 D brick machine	50,000	$1,500
No. 10 S " " "	30,000	1,200
No. 4 " " "	40,000	1,100
No. 7 S " " "	20,000	650
No. 6 S " " "	15,000	575
No. 2 E. H. P. "	6,000	3,360

Coal Mining Machine.



Jeffery.
6 feet undercut ..... $1500 | 5 feet undercut $1400
Jeffery Power Coal Drills.
Air feed drill ..... $275 | Screw feed drill $200
Discount, 10%.

Cork Pullers.

The Samson Cork Puller, per dozen, $12 net.

Crucibles. E. H. Sargent & Co.

Battersea Crucibles, Triangular.

No.	Height. Inches.	Width. Inches.	Crucibles. Per doz.	Covers. Per doz.
S	4½	4⅛	$1.00	$0.50
T	4	3¾	0.80	0.50
U	3½	3¼	0.60	0.40
V	3¼	2⅞	0.45	0.40
W	2⅞	2⅝	0.35	0.30
X	2½	2¼	0.30	0.30
Y	2⅛	2⅛	0.25	0.30
Z	1¾	1¾	0.20	0.20

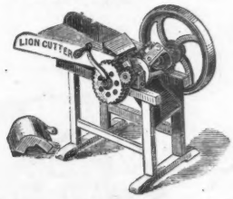
Battersea Muffles, any size, made to order.
See Illustration in advertisement.

No.	Long. Inches.	Wide. Inches.	High. Inches.	Price. Each.
A	7	3⅛	2½	$ .60
B	7½	4⅜	2⅞	.75
C	8	4¾	3	.85
D	8½	5	3¼	1.00
E	9	5½	3⅜	1.15
F	10	6	4	1.25
G	11	4	3⅛	1.09
H	10½	5¼	3⅜	1.00
J	12	6	4	1.25
K	14	8	5	1.75
L	15	9	6	2.00

Export discount .15 %.

Cutters.

FEED.



No. of cutter.	No. of knives.	Length in inches of knives.	Length in inches of feed cut.	Price.
1	2	6¼	⅛, ¾ and 1⅛	$18 00
2	2	7¼	⅛, ¾ and 1⅛	21.00
2½	1	7¼	⅝, ⅞, 1⅛ and 1¾	21.00
2½	2	7¼	⅛, ⅛, ⅝ and ⅞	23 00
3	1	8½	⅝, ⅞, 1⅛ and 1¾	25.00
3	2	8½	⅛, ⅛, ⅝ and ⅞	27.00
4	1	10	⅝, ⅞, 1⅛ and 1¾	30.00
4	2	10	⅛, ⅛, ⅝ and ⅞	33.00
5	2	10	⅛, ⅝, ⅞ and 1¼	35.00
6	2	11	⅛, ¾, 1¼ and 2	45.00
6½	2	11	⅛, ¾, 1¼ and 2	45.00
7	2	13	⅛, ¾, 1¼ and 2	60.00
7½	2	13	⅛, ¾, 1¼ and 2	60.00
10	2	16	⅛, ¾, 1¼ and 2	80.00
12	2	20	⅛, ¾, 1¼ and 2	100 00
11	2	11	⅛, ¾, 1¼ and 2	45.00
13	2	13	⅛, ¾, 1¼ and 2	60.00
16	2	16	⅛, ¾, 1¼ and 2	80.00
20	2	20	⅛, ¾, 1¼ and 2	100.00

The knife arbors for all sizes are made of machinery steel. 30 per cent. dis.

VEGETABLE—GALE'S.

Size.	Weight of Fly Wheel. Pounds.	Will cut per hour. Pounds.	Price
No. 1½	20	1,500	$12
No. 2½	32	1,700	15
No. 3½	52	1,700	15
No. 4	42	2,000	18
No. 5	50	3,000	25
No. 10	65	8,000	35

30% dis.

Duck and Twine.

Baltimore T. & N. Co.—22-inch, Hard, Medium and Soft.

	Weight per yd.	Cents, per yd.		Weight per yd.	Cents, per yd.
No. 0	19 oz.	35	No. 6	13 oz.	26
1	18 "	33	7	12 "	25
2	17 "	32	8	11 "	23
3	16 "	30	9	10 "	21
4	15 "	28	10	9 "	20
5	14 "	27			

Ravens, 2¾-inch.—Eight ounce, 15 cents per yard; Ten ounce, 19 cents per yard; twelve ounce, 22 cents per yard; Fifteen ounce, 27 cents per yard. Dis. 25 and 5%.

Cotton Sail Twine.—Three-fold and upward, 17 to 20 cents per pound. Dis. 3%.

Electroplate.—Babcock & Co.'s.

CASTERS.

1,200—Dinner.

232—Breakfast.

Dinner Casters.
No. 1,200. 17½ in. high, $8.00, quadruple plate.
No. 80. 17 in., $6.00, quadruple plate.
No. 140. 16 in., $7.50, " "
No. 830. 16 in., $5.00, " " Plain, 50 cents less.
No. 25. 16 in., $4.00, double plate.
No. 33. 16 in., $3.75, " "
No. 53. 15 in., $3.00, " "
No. 15½. 14½ in., $2.00, single plate.
No. 19. 14½ in., $1.85, " "
No. 40. 14 in., $1.75, " "

No. 681.

Breakfast Casters.
No. 231. 10 in. high, $4.00, quadruple plate.
No. 232. 12 in. high, $6.00, quadruple plate.
No. 13. 12 in. high, $2.25, double plate.
No. 12. 10½ in. high, $1.75, single plate.

CAKE BASKETS.
Quadruple Plate.
No. 448. 7 in. high-chased, $16; gold lined, $17.
No. 680. 7½ in. high, chased, $7; gold lined, $8.
No. 686. 6½ in. high-chased, $4.50; gold lined, $5.50.
No. 681. 6 in. high, chased, $3; gold lined, $3.50.

BUTTER DISHES.

No. 126. 11 inches high, $5.50.
No. 127. 7 inches high, $5.50.
No. 75. 8 inches high, $1.85.
No. 78. 7½ inches high, $2.00.
Di 60 and 2½ per cent.

No. 90.

CHILD'S SETS.

No. 90. Satin lined case, cup, saucer, knife, fork and spoon, $2.25.
No. 41. Cup, gold lined, in fancy case, $1.15.
No. 43. Cup and saucer, gold-lined, fancy case, $1.15.

FLAT WARE.

Calla Lily, Empress, Windsor and Olive Patterns, 18 Per Cent Nickel Silver Base.

	Extra plate, per doz.	Double plate, per doz.	Triple plate, per doz.
Tea spoons	$4.75	$6.00	$7.25
Dessert spoons	8.50	10.50	12.50
Table spoons	9.50	12.50	14.50
French coffee spoons	4.75	6.00	7.25
Berry or nut spoons	24.00	30.00	36.00
Bar spoons, small	4.75	6.00	7.25
Dessert forks	8.50	10.50	12.50
Medium forks	9.50	12.00	14.50
Oyster forks	7.00	9.00	11.00
Sugar shells	9.00	11.00	13.00
Sugar tongs	25.50	31.50	37.50
Butter knives, twist or reversed handles	10.50	12.50	14.50
Nut picks	4.75	6.00	7.25
Pie knives, engraved blades	42.00	51.00	60.00
Soup ladles	48.00	60.00	72.00

No. 146.

PICKLE DISHES.

No. 144. 12 in. high, $3.50.
No. 66. 10½ in. high, $2; assorted colored glass.
No. 155. 12 in. high, $4; assorted colored glass.
No. 146. 12½ in. high, $9; hand decorated glass.
No. 156. 12½ in. high, $6; hand decorated glass.

No. 255.

TEA SETS.

No. 255. 6 pieces, $35, quadruple plate.
No. 301. 4 pieces, $23, quadruple plate.
No. 1847. 6 pieces, $42, quadruple plate.

ICE PITCHERS.

No. 754. 21 in. high, double wall, $30, quadruple plate.

No. 640. 12½ in. high, double wall, $15, quadruple plate.

No. 751. 12½ in. high. single wall, $6, double plate.

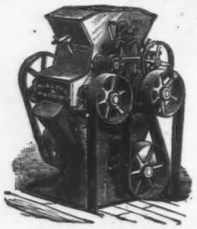
No. 754.

Flue Cleaner.
Hurley's Automatic Steam Flue Cleaner.

No.	Outside diam. of tubes.	With hose clamps.	Globe Valves.	Best 4-ply steam hose. Per foot.
1	1½ to 2	$5.00	½, 95 cents	¾, 67 cents.
2	2 to 2½	6.25	½, 95 cents	¾, 67 cents.
3	2½ to 3	7.50	¾, $1.30	¾, 67 cents.
4	3 to 3½	8.75	1, 1.75	1¼, 83 cents.
5	3½ to 4½	10.00	1¼ 2.90	1¼, $1.04.

Dis. on flue cleaners, 60 and 70%.
Dis. on steam hose, 50%, good to 90 lbs steam.

Flouring Mill Machinery.
Nordyke & Marmon Co.



Roller Mills for Wheat Flour.

Prices of Double and Single Roller Mills.

Size.	All smooth.	½ Corrug. ½ smooth.	All corrug.	Single machines. Corrug.	Single machines. Smooth.
6×12	$465	$475	$480	.....	.....
6×16	515	525	530	.....	.....
6×20	565	575	580	.....	.....
7×14	515	525	530	.....	.....
7×18	560	570	575	.....	.....
7×24	635	645	650	.....	.....
9×18	625	640	650	$350	$335
9×24	700	720	735	390	375
9×30	785	810	830	440	420

20-inch New Era Mill for Wheat, Corn, and Middlings.

Size. Inch.	Power. H. P.	Pulley. Inch.	Capacity Bush.
20	4 to 10	14×7	12 to 40

Speed. Weight. Price.
Lbs.
500 to 800 660 $150

The Nordyke Bradford Portable Mill.

Size of stones. In.	Grinding capacity. Corn, bu. per hour.	Grinding capacity. Wheat bu. per hour.	Horse-power.	Weights. Sing'l gear.	Weights. Double gear.	Pulley mill.	Geared mills. Iron wh'ls.	Geared mills. Mortise wh'ls.
18	8 to 10	.....	4	550	625	$130	$165	$180
20	10 to 12	.....	5	600	700	140	175	190
22	12 to 15	.....	5	700	850	160	190	210
24	15 to 18	.....	6	900	1050	175	210	225
26	18 to 20	8 to 10	8	1200	1400	185	225	250
30	20 to 25	10 to 12	10	1500	1700	225	265	290
36	25 to 30	14 to 17	12	1800	2100	315	355	380
42	35 to 40	19 to 21	15	2000	2300	390	435	460

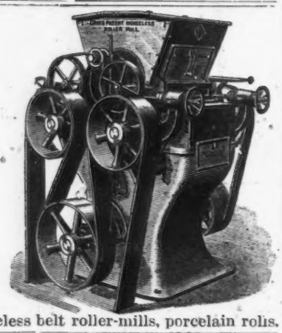
Farm and Plantations Mills.

Diameter of burrs.	Power to drive.	Size of pulley.	Capacity per hour.	Revolutions per minute.	Weight.	Price.
	H. P.					
14 in.	2 to 4	9×5½	4 to 14 bushels	600 to 1200	370 lbs.	$100
18 in.	4 to 10	11×6½	8 to 40 bushels	400 to 700	600 lbs.	130

The Dixey Mill—Stiff Spindle Style.

Size.	Power.	Capacity.	Weight. Pulley.	Weight. Geared	Pulley.	Iron gear.	Mortise gear.
18	4 to 6H.P.	8 to 25 bu	560 lbs	650	$130	$165	$180
22	6 to 8 "	12 to 30 "	800 "	1000	165	200	225
26	8 to12 "	16 to 40 "	1100 "	1500	185	220	245
30	10 to15 "	25 to 60 "	1300 "	1700	215	255	280

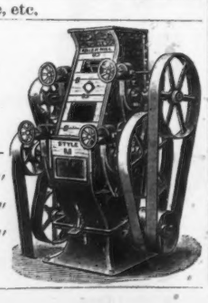
Flour Mills.
E. P. Allis & Co.



Gray's pat. noiseless belt roller-mills, porcelain rolls.

	Size of Rolls.	Driving pulley.	Width.	Length.	Height.	Revolutions per minute.	Approximate power required.	Length of driving belt above floor.	Approximate shipping weight.	Price
With corrugated chilled iron rolls.	14" × 16" single	20" × 6½"	4' 5"	3' 2"	5' 7"	200 to 300	1¾ to 2½ H. P.	16' 3"	2,700 lbs.	$800.00
	14" × 16" double	20" × 6½"	5' 10"	5' 6"	5' 10"	200 " 300	3 " 4 H. P.	19 3"	4,000 "	800.00
	9" × 14"	12" × 5¼"	3' 10"	3' 10"	5' 1½"	300 " 400	1½ " 2½ H. P.	16' 6"	2,700 lbs.	580.00
With Wegmann's patent porcelain rolls.	9" × 14"	12" × 5¼"	3' 10"	3' 10"	5' 1½"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$650.00
Divided four roller machines.	9" × 14"	12" × 5¼"	3' 10"	3' 10"	5' 1½"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$800.00
	14" × 16" single	20" × 6½"	4' 5"	3' 2"	5' 7"	200 to 300	1¾ to 2½ H. P.	16' 3"	2,700 lbs.	$800.00
	14" × 16" double	20" × 6½"	5' 10"	5' 6"	5' 10"	200 " 300	3 " 4 H. P.	19 3"	4,000 "	800.00
	9" × 14"	12" × 5¼"	3' 10"	3' 10"	5' 1½"	300 " 400	1½ " 2½ H. P.	16' 6"	2,700 lbs.	580.00
	9" × 14"	12" × 5¼"	3' 10"	3' 10"	5' 1½"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$650.00
	9" × 14"	12" × 5¼"	3' 10"	3' 10"	5' 1½"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	$800.00
	9" × 14"	12" × 5¼"	3' 10"	3' 10"	5' 1½"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	615.00
	9" × 14"	12" × 5¼"	3' 10"	3' 10"	5' 1½"	300 to 400	1½ to 2½ H. P.	16' 6"	2,700 lbs.	625.00

For grinding corn, feed, rye, etc.



Size.	Height.	Width.	Length.
6" × 12"...	4' 6"	3' 5"	2' 7"
9" × 14"...	5' 8"	3' 10"	3' 5"
9" × 18"...	5' 8"	4' 9"	3' 5"
9" × 24"...	5' 8"	5' 6"	3'

Driving pulley.	Revolutions per minute.	Length of belt above floor.	Approximate shipping weight	Price.
10" × 5¼"	400 to 500	14'	.....	$500.00
14" × 6¼"	350 to 450	18'	2600 lb.	600.00
14" × 7¼"	350 to 450	18'	3050 lb.	650.00
14" × 8¼"	350 to 450	18'	3350 lb.	735.00

Forges (Portable).
Fairbanks.

No. 2c,	weight,	155 lbs.	21 × 27	hearth.....	$42.00
" 3a,	"	80 "	18 in. diam.	hearth.....	27.00
" 3b,	"	75 "	18 "	"	24.00
" 3c,	"	85 "	18 "	"	30.00
" 6a,	"	45 "	14 "	"	18.00
" 6B,	"	45 "	14 "	"	16.00

Dis. 60%.

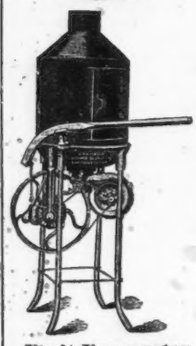
Bullock's (Portable.)

No. 1, 18 in. bellows, $20; No. 2, 20 in. bellows, 25; No. 3, 22 in. bellows, $30.
20% dis.
Stationary.
27 in. bellows, $21; 30 in. bellows, $25; 33 in. bellows, $33; 36 in. bellows, $45.
20% dis.

Riveting Forges.

Bellows, 18 in. 20 in., 22 in., 24 in., $8.00. $10.00. $13.00. $17.00.

20 % dis.



Empire.

Light work, 12 × 17; height, 15 in., $16.00.

Same, with Hood, 12 × 17; height, 28 in., $20.00.

Bridge, Boiler or Railroad work, Pan, 17 × 19; height, 29 in.; Fan, 8 in., $27.00.

Same, with Hood, $30.00.

Water Tank, $4.00 extra.

Iron Fire Ring Round Tuyere, $1.00 extra.

50 % dis., f.o.b. at Cohoes.

Fruit Evaporator.

No. 1. Evaporator..... $30
No. 2. Fruit Drier and Baker, with Bleacher attachment. Weight, 225 lbs. Capacity, 5 to 7 bushels apples per day; 24 in. deep, 26 in. wide, 5½ ft. high; 12 trays, 22 22; 40 square feet drying surface. Complete..... $50
No. 3. Capacity, 15 to 20 bushels per day..... 100
No. 4. Capacity, 20 to 30 bushels per day..... 16
Dis., No. 1, 3 and 4 = 20%.
" 2 = 30%
Boxing, extra:
No. 1, $3.00; No. 2, $5.00; No. 3, $7.50; No. 4, $12.50.
Freight to New York:
No. 1, $4.00; No. 2, $6.00; No. 3, $12.00; No. 4, $18.00.

Fruit Presses.
P., D. & Co..... per doz., $4.50

Glass Tube Cutters.

One Arm Carries Rotary Cutter, Price, $2.50 each.

Glassware.

6-in. bowl and cover, per doz..... $3.25
7-in. " " " 4.50
8-in. " " " 6.00
9-in. " " " 8.00
10-in. " " " 10.50
Net.

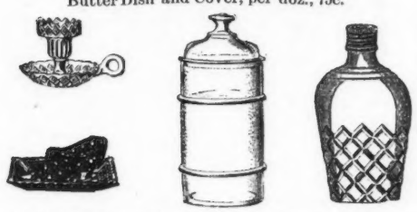
Nappy, 4½-inch., per doz., 50c.; 6-inch., per doz., $2; 7-inch., per doz., $3; 8-inch., per doz., $4.
Cream Pitcher, 1 pint, per doz., $1.25; one quart, per doz., $3.50; 3 pints, per doz., $4.50.
Pint Pitcher, per doz., $1.50; quart pitcher, per doz., $2; ½ gallon pitcher, per doz., $3; 3 quart pitcher, per oz., $4.50.

Flange Butter and Cover, per doz., $1.75.
Water Set, per doz., sets of 60 pieces, $7.50.

Cheese Dish and Cover, 8 in., per doz., $4.50.
Quart Water Bottle, per doz., $4.50.

Ind. Salts; per gross, $2.00. Assorted patterns.
4 Bottle Castors, per doz., $7.50; 3 bottle, per doz., $4.50.

Berry Dish, 4½-inch , per doz., 50c.; 10-inch, per doz., $4.
Butter Dish and Cover, per doz., $1.25.
Butter Dish and Cover, per doz., 75c.



Candlesticks, per doz., $2.00. Glass Slipper for Flowers, per doz., 50 cents; slipper and tray, per doz., $1. Jam Jar and Cover, 1 qt., per doz., $2.50; ½ gal., per doz., $3.25; ¾ gal., per doz., $4; 1 gal., per doz., $5; 1½ gals., $9; 2 gals., per doz., $12. Pocket Flask, 1 pint, $1.

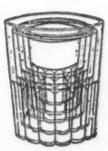
Tumblers.

1¾ oz., per doz. 50 cents.
8 " " 75

9 oz., per doz., $2.75.

11 oz., assorted patterns, per doz., 30 cts.

9½ oz., assorted patterns, per doz., 25 cts.



1 oz. to 12 oz., nested for shipping, per doz. nest, $2.

Goblets, banded, per doz., 65 cents.
Claret to match, per doz., 55 cents.
Wines, to match, per doz., 50 cents.
Cordials, to match, per 45 cents.

Banded, open, hollow stem.

Goblets, per doz., 50 cts.
Claret, " 50 "
Wine, " 35 "

Champagne, per doz., $1.25.

½ Pt. tumbler, per doz. .55 cts.
½ Pt. mug to match, " .65 "
Goblet, " " .50 "
Spoon holder, cream pitcher, sugar, butter dish to match.
Sets of 4 pieces, per doz. sets, 48 pieces, $3.75.

Hammers.

H. Cheney Hammer Co.

Adz-eye Hammers.—Per Dozen.

No.	Weight.		No.	Weight.	
5.	Round.	1 lb., 4 oz.	$9.00	7½	Round. 13 oz.	$8.00
7.	"	1 lb.	8.50	8	" 7 oz.	7.50

Adz-eye Hammers.—Per Dozen.

No. 17. Octagon. weight, 1 lb., 4 oz. $9.00

Adz-eye Hammers.—Patent Nail Holder.—Per Dozen.

No.	Weight.		No.	Weight.	
33.	Bell-face.	1 lb., 4 oz	$9.50	35.	Round h.	1 lb., 4 oz	$9.50
34.	"	1 lb.	9.00	36.	"	1 lb.	9.00

Adz-eye Hammers.—Bell Face.—Per Dozen.

No.	Weight.		No.	Weight.	
37.	1 lb., 4 oz.	$9.00	38½.	13 oz.	$8.00
38.	1 lb.	8.50	39½.	7 oz	7.50

Farriers' Hammers.—Per Dozen.

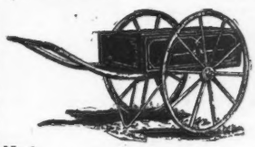
No.		Weight.	
55.	Adz-eye. Octagon.	9 oz.	$7.75
56.	"	7 oz.	7.50
57.	Plain. "	7 oz.	6 25
58.	Plain Brad.	4 oz.	5 50
60.	Adz-eye, Round Head.	7 oz.	7 50
61.	" Octagon. Boston pattern	10 oz.	8.00
62.	" "	7 oz.	7.50

Machinists' Ball Pein Hammers.—Octagon.—Per Dozen.

No.	Weight.		No.	Weight.	
90.	3 lbs.	$22.00	94.	1 lb., 4 oz.	$13 50
90½.	3 lbs., 8 oz.	19.00	95.	1 lb.	12.50
91.	4 lbs., 4 oz	17.50	96.	12 oz.	12.00
92.	2 lbs.	16.50	97.	8 oz.	12.00
92½.	1 lb., 12 oz.	15.50	98.	6 oz.	12.00
93.	1 lb., 8 oz	14 50			

Discount, 35 and 5 per cent. Net Cash, 30 days. 10 per cent. Cash, 10 days. Cases at Cost.

Hand Carts



No. 0 42 wheel, 1 in. tread, 1 in. axle box 48x28x10 deep, $10.50.
No. 1, 36 wheel, 1 in. tread, ⅞ in. axle, box 40x23x10 deep, $9.00.
No. 2, 30 wheel, ¾ in tread, ¾ in. axle, box 32x20x9 deep, $8.25.
With Wagon-Seat Spring.
No. 6, same sizes as

No 0	$12.00
" 7, same sizes as No. 1	10.50
" 8, " " " No. 2	9.75

With Third Wheel, Without Springs.

No. 3, same sizes as No. 0	$12.00
" 4, " " " No. 1	10.50
" 5, " " " No. 2	9.5

Handles.

	Doz.		Doz.
Extra, Axe 36-inch	$1.90		
No. 1	$1.50	No 2	1.10
Extra, Axe, Boys, 26 and 28 inch	1.25		
No. 1	$1.15	No. 2	85
Extra, Axe, Broad or Squaring	2.00		
No. 1	$1.50	No. 2	1.25
Extra, Adz Colonial, Ship and R. R., 34 and 32-inch.	2.00		
No. 1	$1.60	No. 2	1.25
Extra, Pick R. R., 36-inch.	2.00		
No. 1	$1.40	No. 2	1.10
Extra, Pick Square Eye Miners' 34, 33 and 32-inch.	2.00		
Extra, Square Eye Driving 34, 33 and 32-inch.			
No. 1	$1.50	No. 2	1.25
Extra, Pick Square or Oval Eye Miners' or Drifting Pick, 34 and 32-inch	2.00		
No. 1	$1.45	No. 2	1.20

Sledge Hammer, Tool, Maul, Straight Taper.

		Extra.			Extra.
24-in.	No. 1,	$ 65;	$ 80	34-in.	No. 1,	$ 95;	$1.10
26-in.	No. 1	75;	90	36-in.	No. 1,	1.05;	1.20
28-in.	No. 1,	80;	95	38-in.	No. 1,	1.15;	1.30
30-in.	No. 1,	85;	1.00	40-in.	No. 1,	1.35;	1.40
32-in.	No. 1,	90;	1.05	42-in.	No. 1,	1.60;	1.75

Blacksmith Hammer, Machinist Hammer, Hand Hammer.

	Per. doz. Extra.		Per doz. Extra.
14-in.	No. 1, 35c.; 45c.	20-in.	No. 1, 65c.; 75c.
16-in.	No. 1, 45c.; 55c.	22-in.	No. 1, 70c.; 80c.
18-in.	No. 1, 55c.; 65c.	24-in.	No. 1, 75c.; 85c.

Adze Eye and Round Eye Hammer, 12, 13, 14, 15 in., per doz. ..... 30c.
Shingling and Lath Hatchet, 12, 13, 14, 15 in., per doz. 30c.
Broad Hatchet.

Per doz.		Per doz.
16-in.	50c.	18-in.	55c.
17-in.	50c.	19-in.	55c.

Dis., 10.10 and 2 %.

Hardware Specialties.

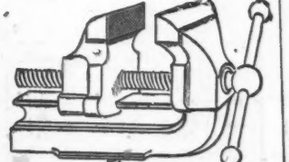
AUGERS.
Patent Adjustable Hollow.
Cuts from ¼ to 1¼, pivoted jaws, graduated scale to 1-16ths, per doz., $60.00.
Discount, 15 and 10%.

Patent Hollow Auger.

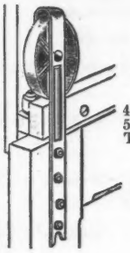
Inch	5-16	⅜	7-16	½
With bits	12.00	12.00	12.00	12.00
Without bits	8.00	8.00	8.00	8.00
9-16	⅝	¾	⅞	1	1⅛
14.00	14.00	14.00	16.00	16.00	20.00
9.00	9.00	9.00	13.00	13.00	14.00
1¼	1⅜	1½			
20.00	24.00	24.00			
14.00	16.00	15.00			

Discount, 15 and 10%.

BENCH DRILL.
Adjustable bed plate.
26½ high drills to ½ in. hole, 3½ run of screw.
List price, each $10.00
Net, " 3.75

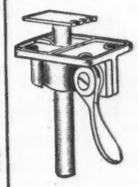


Bench Vise, Steel Jaws, 3½ in., opens 3 in.; weight, 12 lbs.; list price, each, $4.60.; net price, each, $1.60.



BARN DOOR HANGER.

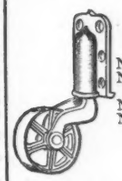
4 in., per doz. pairs $12.00
5 " " " 14.40
Track, per foot ..... .60
One dozen pairs in case.
Dis., 50%.



BENCH HOOK.
Patent, adjustable and reversible.
List $9 dozen, ½ dozen in box.
Discount, 20 and 10%.

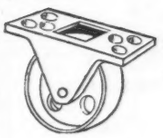
BLACKSMITH'S TONGS.
Swivel Jaw.

No. 1, 16 in., per doz. $10.00
" 2, 18 " " 10.00
Dis. 20%.

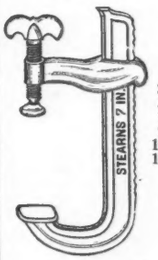


CASTERS.
Swivel Store Truck.

No. 20, japanned, 4 in. wheel, each ..... .55
No. 25, " 5 " " " ..... .75
Noiseless turned wheel.
No. 30, japanned, 4 in. wheel, each 1.30
No. 35, " 5 " " " 1.60
Discount, 25%.



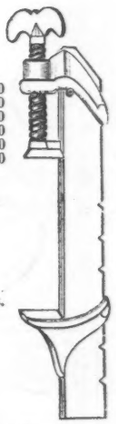
Store Truck, stationary.
No. 50, 5-inch wheel, 1½ inch wide, each, $1.05.
No. 60, 5-inch, extra heavy, 1½ inch wide, each $1.50.
Discount, 25%.



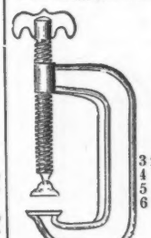
SCREW CLAMPS.
Adjustable.

3 in., per doz.	$4.00
5 " "	6.50
7 " "	9.00
9 " "	10.50
12 " "	15.00
16 " "	20.00

½ doz. in box.
Discount, 20 and 10%.



CLAMPS.
New Door Frame.
3 ft. long, per doz., $8 list; $5 per doz. net.



Malleable Iron Screw Clamps.

Per Doz.		Per Doz.	
3 in.	$7.00	7 in.	$20.00
4 "	10.00	8 "	25.00
5 "	12.00	9 "	27.50
6 "	16.00	10 "	30.00

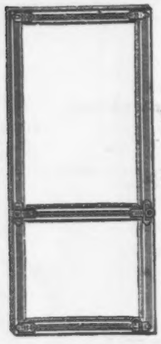
3, 4, 5, 6 in., ½ doz. in box.
Dis., 70%.

CLOTHES REEL.
Extra heavy, gray iron, japanned.
List per doz. $18.00
Net 7.00

JACK SCREWS.
New pattern wrought iron screw.

No.	Rise of screw.	High.	Diameter screw.	Price.
20	4½ in.	10 in.	2 in.	$4.50
25	6½ "	12 "	2 "	5.25
30	8½ "	14 "	2 "	5.75
7	11½ "	16 "	2 "	6.50

Discount, 40%.



DOOR SCREEN FRAMES.

Patent Corners.

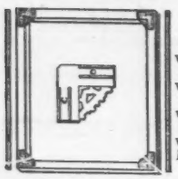
No. 22, 3 by 7 ft. sticks, ⅞ by 2, per doz. sets, $11.

No. 24, 3½ by 8 ft. sticks, ⅞ by 2, per doz. sets, $12.

No. 26, 3 by 7 ft. sticks, ⅞ by 2½, per doz. sets, $12.50.

No. 28, 3½ by 8 ft. sticks, ⅞ by 2½, per doz. sets, $14.50.

Dis., 20%.



WINDOW SCREEN FRAMES.

Patent Japanned Corners.

No. 25, 36 by 36 corners and screws, without bead, per doz., $2.50.
No. 25, 36 by 36 corners and screws, with bead, per doz., $2.90.
No. 35, 42 by 42 corners and screws, without bead, per doz., $2.90.
No. 35, 42 by 42 corners and screws, with bead, per doz., $3.30.
Black satin stain, sticks ⅞ by 1 in. Dis., 20 %.

PULLEYS.

Side, No. 45, Japanned.

Inches...	1	1½	2	2½	3	4	5
Per doz..	.90	1.00	1.60	2.40	3.50	9.00	15.00

2 inch and under, 2 dozen in box: 2½, 3 and 4, 1 dozen in box; 5 inch, ½ dozen in box.

Discount, 50%.

PULLEY HOOK (New Floor.)

Deep cut thread, forged point.

	Per doz.
¾ in. wrought iron, 8 in. long, list	$1.90
net	1.00

WEIL WHEEL.

New pattern.

Japanned.

In.	8	10	12	14	16
Pr.d.	7.00	9.50	12.50	20.00	30.00

Discount, 70%.

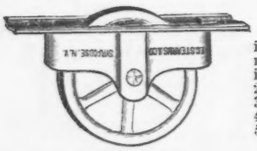
HAY FORK PULLEY.

New pattern.

No. 15, 5 in. iron wheel, per doz.	$4.50
25, 5 in. wood " "	4.50
66, 6 in. " "	6.00

4 dozen in case, 8 dozen in barrel.

No. 15, per dozen, $2 net.



SHEAVES.

Patent Common

Turned and polished iron wheels, round corners, brass pin, one set in box.

2½ inch	$1.50
3 "	1.60
4 "	2.00
5 "	2.60

Discount, 50%.

SINKS.

All 6 inch deep.

14 × 20 in....	$1.50	18 × 30 in....	$2.50
15 × 25 in....	1.75	18 × 32 in....	3.00
15 × 27 in....	2.00	18 × 36 in....	3.00
16 × 24 in....	1.80	20 × 30 in....	3.00
16 × 28 in....	2.10	20 × 36 in....	3.70
17 × 30 in....	2.25	20 × 40 in....	4.00
18 × 24 in....	2.10		

Discount, 60%.

SPOKE POINTERS.

	Per doz.
No. 1, points 1⅞ in. diameter,	$9.00
No. 2, points 2⅜ in. diameter,	$15.00

Discount, 15 and 10%.

½ dozen in box.

VISE.

(Bench Vise, Steel Jaws.)

3½ in. opens 5 in., weight 12 lbs.

List price, each	$4.00
Net " "	1.60

Silent Saw Vise.

No. 10., 10 in. jaw, per doz.... $15.00

Dis., 33⅓%.

Moore & Barnet Mfg. Co.

No.	per dz.	gr., lbs. per gr.
1 Amateur vise	$2.25	70
Anvil.		
2	3.75	200
3	11.25	615
4	18.00	1,350
10	24.00	1,675

No. Clamp.	per dz.	gr., lbs.
1½	3.00	80
2½	5.00	220
3½	14.25	700
4½	21.00	1,425
Combination hand	5.25	85

Spot cash discount, 33, 20 and 2, f.o.b.

Nos. 1, 1½, 2 and 2½ are packed in dozens; Nos. 3 and 3½ in half dozens; Nos. 4, 4½ and 10 in quarter dozens, and No. 20 singly. Each hand vise is put up in neat box and packed in half dozen lots.

1 Hinge pipe vise, 0 to 2 in. pipe..... Each $10.00
2 " " 0 to 4 in. pipe..... 20.00
1 Malleable pipe vise, 0 to 2 in. pipe..... 8.00
1 Combination pipe and bench vise, 0 to 2 in. pipe... 16.00
Discount, 50%.

WRENCHES.

Coes' Knife Handle Wrenches.

BLACK.

Size.	₱ doz.	Size.	₱ doz.
6 inch	$9.00	15 inch	$24.00
8 "	10.00	18 "	30.00
10 "	12.00	21 "	36.00
12 "	14.00		

BRIGHT.

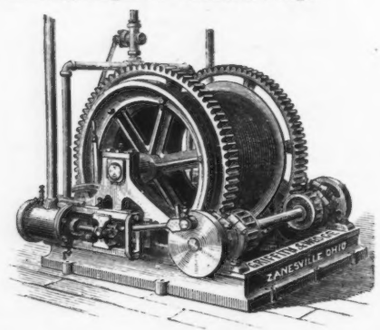
4 inch	$10.00	12 inch	$16.00
6 "	10.00	15 "	26.00
8 "	11.00	18 "	32.00
10 "	14.00	21 "	38.00

Discount, 55, 10, 7½ and 3 %.

Coes Mechanics' Screw Wrenches, same list, less 55, 10, 10, 7½ and 3 %.

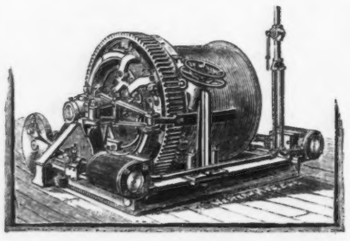
A. G. Coes & Co. Pat. Screw Wrenches, same list as above. Discount, 55, 10, 7½ and 3%

Hoisting Engines.—Griffith & Wedge.



	Weight.	$
Hoisting Engines, Miner's Prospecting	4,000	750
Hoisting Engines, No. 1 Double Cylinder	4,500	800
Discount, 20%.		
" " No. 2 Double Cylinder	6,000	1,000
" " No. 3 " "	11,000	1,550
" " No. 4 " "	15,500	1,800
" " No. 5 " "	17,000	2,100
" " No. 6 " "	13,600	1,750
" " No. 7 " "	17,000	2,100
" " No. 8 " "	19,000	2,400
" " No. 9 " "	48,000	4,500

Discount, 25%.



Webster, Camp & Lane Machine Co.

Single drum. No.	Average Load. Pounds.	Double drum. Approx. weight, complete. Pounds.
$825.00 = 5	1,950	6,000 = ...
918.50 = 6	1,650	6,500 = ...
1.177.00 = 7	2,200	8 000 = $1.661 00
1,331.00 = 8	3,000	8,500 = 1,815.00
1.694.00 = 9	3.500	14.000 = 2.722 50
1.914.00 = 16½	3,700	16,000 = 3,124.00
2.343.00 = 17½	5.500	19,000 = 3,333.00
2,475.00 = 18	5.500	22,000 = 3,872.00

India Rubber Goods.

MECHANICAL.

Commonwealth Rubber Co.

RUBBER BELTING.

Inches.	2 ply. per foot.	3 ply per foot.	4 ply per foot.	5 ply per foot.	6 ply per foot.
1	$0.07	.....	.....	.....	.....
1¼	0.09	.....	.....	.....	.....
1½	0.11	.....	.....	.....	.....
2	0.15	$0.17	$0.21	.....	.....
2½	0.18	0.22	0.26	.....	.....
3	0.22	0.26	0.31	.....	.....
3½	0.26	0.30	0.37	.....	.....
4	0.30	0.34	0.42	.....	.....
4½	0.33	0.39	0.47	.....	.....
5	0.36	0.43	0.52	.....	.....
6	0.43	0.52	0.62	.....	.....
7	0.51	0.60	0.73	.....	.....
8	0.59	0.70	0.84	$1.05	$1.25
9	0.67	0.80	0.95	1.18	1.42
10	0.75	0.90	1.07	1.33	1.60
11	0.83	1.00	1.18	1.47	1.77
12	0.91	1.08	1.30	1.62	1.95
13	1.00	1.18	1.42	1.77	2.13
14	1.08	1.28	1.54	1.92	2.31
15	1.16	1.38	1.66	2.07	2.49
16	1.25	1.50	1.78	2.22	2.67
18	1.41	1.70	2.02	2.52	3.03
20	1.58	1.90	2.26	2.82	3.39
22	1.76	2.12	2.52	3.15	3.74
24	1.96	2.36	2.80	3.50	4.20
26	2.18	2.60	3.08	3.85	4.62
28	2.42	2.84	3.36	4.20	5.04
30	.....	.....	3.64	4.55	5.46
32	.....	.....	3.92	4.90	5.88
34	.....	.....	4.20	5.25	6.30
36	.....	.....	4.48	5.60	6.72
38	.....	.....	4.76	5.95	7.14
40	.....	.....	5.04	6.30	7.56
42	.....	.....	5.32	6.65	7.98
44	.....	.....	5.60	7.00	8.40
46	.....	.....	5.88	7.35	8.82
48	.....	.....	6.16	7.70	9.24
50	.....	.....	6.44	8.05	9.66
52	.....	.....	6.72	8.40	10.08

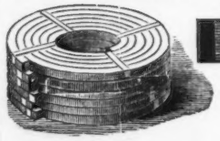
Dis. Reliance, 60 and 5. Dis. Royal, 60, 10 and 10. Dis Manhattan, 70 and 5.

See Link Belting, page 9.

PACKING.

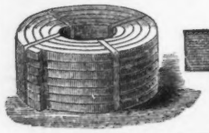
Piston Packing.

Round Piston Packing Per lb. 85c. Discount, 60, 10 and 5 per cent.



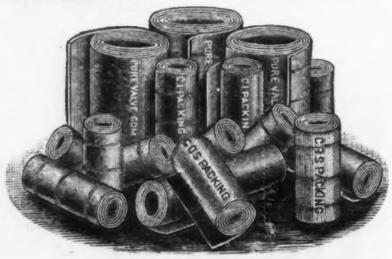
Square Piston Packing.

Price same as above. Round and square piston packing is made in lengths of twelve or twenty-four feet.



Square Piston Packing. Rubber back, per pound $1. Discount 60 der cent. Best only.

Square piston packing, rubber back is made in lengths of twenty feet.



Steam Packing.

Cloth Insertion, Rubber Outside.

Cloth Insertion, Cloth on one or both sides.

Thickness.	1-Ply.	2-Ply.	3-Ply.	4-Ply.
1-64 inch	70 cts.	.....	.....	.....
1-32 "	65 cts.	.....	.....	.....
1-16 "	60 cts.	63 cts.	66 cts.	.....
3-32 "	55 cts.	58 cts.	61 cts.	.....
1-8 "	55 cts.	55 cts.	58 cts.	61 cts.
3-16 "	55 cts.	55 cts.	55 cts.	58 cts.
1-4 "	55 cts.	55 cts.	55 cts.	55 cts.

One-ply of cloth to every 1-16 inch thickness.

Three cents per pound additional will be charged for each extra ply of cloth. Each cloth, whether insertion or on outside, to count as one ply.

All cloth insertion or plain packing is one yard wide, and any length desired.

Wire insertion packing, all thicknesses, per lb, 50 cents.

Discounts: Reliance, 70 & 10; Royal, 60, 10 & 10; Manhattan, 60 per cent.

See "Link" Packing, page 9.

HOSE.

Improved "Smooth Bore" Rubber Suction Hose.
On spiral flat or round tinned steel wire.

Int. Diam.	Per ft.
2 inch	$2.60
2½ "	3.50
3 "	4.00
3½ "	5.50

In. Diam.	Per ft.	Per Diam.	Per ft.
4 inch	6.50	7 inch	$13.50
4½ "	7.50	7½ "	15.00
5 "	8.50	8 "	16.31
5½ "	9.50	9 "	19.50
6 "	10.50	10 "	22.50
6½ "	12.00	12 "	27.50

Suction hose discount: Reliance, 50 and 10%; Royal, 60, 10 and 5%; Manhattan, 70 and 5%.

SUCTION HOSE.

On spiral brass or iron wire

Int. Diam	Per. ft.
¾ inch	$ .77
1 "	1.00
1¼ "	1.25
1½ "	1.65
1¾ "	2.10
2 "	2.50

RUBBER HOSE.

Conducting Hose—Two-ply.

Int. diam.	Per ft.	Int. diam.	Per ft.	Int. diam.	Per ft.
½ in	$0.20	2 in	$0.66	5 in	$1.65
¾ in	25	2¼ in	75	6 in	1.98
1 in	33	2½ in	83	7 in	2.31
1¼ in	42	2¾ in	92	8 in	2.64
1¼ in	50	3 in	99	9 in	2.97
1¾ in	58	4 in	1.32	10 in	3.33

HYDRANT HOSE—THREE-PLY.

½ in	$0.25	1½ in	$0.60	2½ in	$1.00
¾ in	30	1¾ in	70	2¾ in	1.10
1 in	40	2 in	80	3 in	1.20
1¼ in	60	2¼ in	90	3½ in	1.40
				4 in	1.60

Discount—Reliance, 60; Royal, 70; Manhattan, 70 and 10 per cent.

GASKETS AND RINGS.

Fibrous.
¼ inch thick, or less, per lb. $0.90
5-32 inch thick, and upwards, per lb. $0.80
Cloth Insertion.
1-16 inch thick, or less, per lb. $1.25
3-32 inch thick, and upwards, per lb. $1.00
There is one ply of cloth to every 1-16 in thickness.
Five cents per pound additional for each extra ply of cloth.

Dis., 60, 10 and 5%.

CORRUGATED RUBBER MATTING.

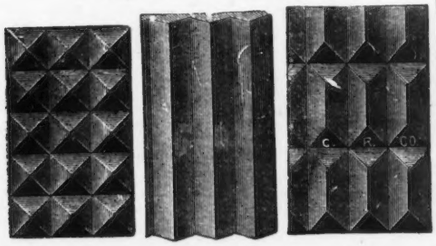
Rolls 1 yard wide, 30 yards long, cut to any size required.

3-32 in. thick, per sq. ft.	$0.33
⅛ " " "	0.40
3-16 " " "	0.56
¼ " " "	0.73
⅜ " " "	1.03
½ " " "	1.30

Dis., 25 and 5%.

TENNIS SHOE SOLING.

Cuts show full size of pattern.



Diamond Point, Corrugated, Oblong,
Price, $1 per lb.
Rubber cement to attach soles furnished.

STAIR TREADS.

No.	Inches.	Thick.	Per doz.	Thick.	Per doz.
1.	6 x18	⅛	$4.00	⅜	$3.30
2.	7 x24	⅛	6.00	⅜	5.00
3.	4 x39	⅛	5.50	⅜	4.70
4.	7 x40	⅛	10.00	⅜	8 30
5.	7½x42	⅛	11.00	⅜	9.10
6.	7½x48	⅛	12.50	⅜	10 40
7.	9 40	⅛	12.50	⅜	10.40
8	9 x48	⅛	15.00	⅜	12.50
9.	9 x36	⅛	11.25	⅜	9.40
10.	6 x48	⅛	10.20	⅜	8 0
11.	7 x28	⅛	7.00	⅜	5 85
12.	9 x54	⅛	16 80	⅜	14 00
13	8 x52	⅛	14.60	⅜	12.15
14.	10 x24	⅛	8.40	⅜	7.00

RUBBER SOLING FOR BOOTS.

Rough finish, 1-16 to 3-16 thick.
Smooth finish. 1-32 to 1-16 thick.
85 cents per lb.

Indurated Fibre Ware.

SPITTOONS.

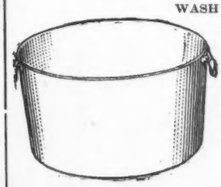
	Doz.
16 in. dia., 8 in. high	$24.00
12½ in. dia., 5¼ in. high	10.80
9 in. dia., 5 in. high	7.80

Dis. on all 25 and 20%.

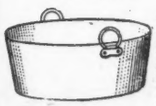
CORDLEY & HAYES.

Pails.	No. doz. in crate.	Cubic feet.	Price per doz.
Ladies' or Weaver's pails, 6 qt.	1	2¾	$5.35
Half or buggy pails, 6 qt.	1	3	4.80
Star pails (standard plain), 12 qt., stenciled "for fire only" without extra charge.	1	3½	6.00
Deck or Mason's pails (same size as Star, but heavier, with heavy wire bail).	1	4	6.60
Railroad or fire pails, 14 qt. (also stenciled "fire" without extra charge).	½	3½	7.80
Fire pails, round bottoms	1	4	7.80
Milk pails, 14 qt.	1	4	7.80
Stable pails, flush bottom, heavy wire bail, 14 qt.	1	4	7.80
Stable pails, 16 qt., same as above	½	3½	8.40
" 18 " " "	½	3¾	10.70
" 20 " " "	½	4	12.00
Covers for fire or star pails.	1		3.35

WASH TUBS.



No. 0, 23 in.	½	12	27.00
Nos. 0, 1, 2 and 3, nested	1 n.	3½	22,50
No. 1, 21 in.	½	10½	24.00
No. 2, 19½ in.	½	9	21.00
No. 3, 18½ in.	½	9	18.00
Nos. 1, 2, and 3, nested	½	9¾	21.00



KEELERS.

		Doz.
A—20 in.	7 in. deep	16.20
B—19 "	" "	15.00
C—18½ "	" "	14.00
1—17½ "	" "	13.20
2—15½ "	6 in. "	12.00
3—13½ "	5 in. "	10.20
4—12 "	4 in. "	9.00

MILK OR VEGETABLE PANS.

13¼ in. dia., 3¼ in. deep, 6 quarts,
$3.60 per doz.

WASH BASINS.

	Doz.
12¼ in.	$4.80
12½ in.	4.20
11½ in.	3.60

CHAMBER PAILS.

12 in. dia., 9 in. deep, 3 gal. 16.00

WATER COOLERS.

	Doz.
3 gal.	$32.00
4 "	40.00
5 "	44.00
6 "	48.00
8 "	64.00
10 "	80.00
12 "	96.00
15 "	120.00

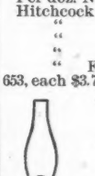
WATER COOLERS AND FILTERS.

	Doz.
4 gal.	$96.00
5 "	108.00
6 "	120.00
8 "	144.00
10 "	192.00
15 "	288.00

Lamps. F. H. Lovell & Co.

Miners'.
Brass, Collar and Breast in one piece, Spout and Body in one piece.
Price, $9 per gross net.

Drummond Electric Hanging Lamp, 300 candle power, complete, each $3.50.
The electric lamp, 60 candle-power.
With decorated shades, nickel, per doz. $22.00
With opal plain shades, nickel, per doz. 18.00.
With decorated shades, brass, per doz. 21.00.
With opal plain shades, brass, per doz. 17.00.
Lamp chimney patent for Sun burners.
Per doz. No. 0, 50 cents. No. 1, 60c. No. 2, 75c.
Hitchcock nickel table lamp (No. 654), each $3.75
" " hanging " 656 " 7.25
" " bracket " 651 " 4.00
" " " with reflector 653 " 4.00
" French bronze bracket, with reflector, No. 653, each $3.75.



Harp, complete, with square tin shade, per doz., $9.50.
Complete, with Burner and chimney, per doz., $1.50.
Hurricane lanterns 25 cents extra with guards.
875, ¾ wick, without guards, per doz., $5.00.
876, square safety lifting globe, per doz., $5.50.
877, ⅞ wick, safety lifting globe, per doz., $6.75.
Nickel plated diamond reflector reading lamp, 30 candle-power, $13.50 per doz.
Net.
Illuminated night clock, per doz., $27.

PAPER LAMPS.

Lined with oil proof composition.

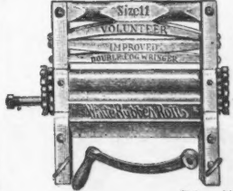
	No. 0.	No. 1.	No. 2.
Height, 2½ in.	3 in.	3¾ in.	
Diameter, 3½ in.	2½ in.	2½ in.	
Weight, ⅌ doz., 3¾ lbs.	1¾ lbs.	2 lbs.	
Price, $2.75 per doz.	$2.25	$2.75	

	No. 0.	No. 3.	No. 4.
Height, 2½ in.	5 in.	6½ in.	
Diameter, 3½ in.	3½ in.	4 in.	
Weight, ⅌ doz., 3¾ lbs.	3½ lbs.	7 lbs.	
Price, $2.75 per doz.	$3.25	$4.50	

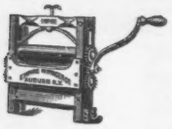
Dis., 20%.

Laundry Appliances.

EMPIRE CLOTHES WRINGERS.



Rolls.
"Volunteer." Length, 10 in. x1¾ in. dia. $40 per doz.
"Volunteer." Length, 11 in. x1¾ in. dia. $50 per doz.
"Volunteer." Length 12 in. x1¾ in. dia. $50 per doz.
Dis., 40%.
"Daisy." Length, 10 in. x1¾ in. dia. $30 per doz.
"Daisy." Length, 12 in. x1¾ in. dia. $48 per doz.
Dis., 40%.



"Empire." Length, 10 in.x1¾ in. dia. $63 per doz.
"Empire." Length, 11 in.x1¾ in dia. $74 per doz.
"Empire." Length, 12 in.x1⅞ in. dia. $84 per doz.
"Empire." Length, 12 in.x1⅞ in. dia. $87 per doz.
"Empire." Length, 14 in.x2¼ in. dia. $156 per doz.
"Empire." Length, 14 in.x2¼, with pulleys. $220 per doz.
"Empire." Length, 16 in.x2½, with pulleys. $360 per doz.
Dis., 40%.

EMPIRE CLOTHES DRYING BARS. $10 per doz. Dis., 40%.

Closed. Open for use.

EMPIRE FOLDING WASH BENCHES
$15 per doz. Dis., 40%.

Royal Keystone cog wheel, 10 by 1¾ rolls, $36 per doz.
No. 10, wood frame cog wheel, 10 by 1¾ rolls, $24.50.
No. 16, wood frame cog wheel, 11 by 1¾ rolls, $29.
No. 18, wood frame cog wheel, 11 by 1⅞ rolls, $33.50.
No. 20, wood frame cog wheel, 11 by 2 rolls, $39.50.
No. 22, wood frame cog wheel, 12 by 1⅞ rolls $39.50.
No. 24, wood frame cog wheel, 12 by 2 rolls, $48.50.
No. 11, iron frame cog wheel, 10 by 1⅝ rolls, $20.
No. 2, iron frame cog wheel, 10 by 1¾ rolls, $24.
Solance iron frame (Eureka Pat.), 10 by 1¾ rolls, $20.
Solance iron frame (Eureka Pat.), 11 by 1¾ rolls, $24.50
F.o.b. cars at works; 60 cents doz extra f.o.b. New York.
Keystone Double Bench Wringer.
Rolls, 10 by 1¾, $36.50 per doz.
Made to fold.
Folding Double Folding Wash Bench, packed 6 in crate per doz., $14.
Adams Ironing Table, per doz. $15.00
Keystone Washing Machines, per doz. 24.00
Complete " " " 13.50
People's " " " 13.50
Lovell " " " 13.50

Net prices.
Cabinet Clothes Driers, per doz., $21.00 net,
Excelsior Clothes Horse, per doz., $6.00 net.

Reversible Clothes Horse.

	High.	Per doz.	
A	3 ft	$14.00	Dis., ash, 50 and 10%.
B	3 ft. 10 in.	16.00	
C	4 ft. 10 in.	18.00	
D	5 ft. 10 in.	20.00	Basswood, 60 and 10%.

Nursery Reversible Clothes Horse.
2 section, 3 ft. high, per doz. $9.00
" " " 12.00
" " " 16.00
Black Walnut Bronze Tips and Hinges. Dis., 30%.

WASHBOARDS.
The following prices are on orders of not less than 25 dozen of one kind or an assortment.
Wilson, one rubbing surface, per doz., $1.40.
Saginaw, one rubbing surface, per doz., $1.25.
Exchange, one rubbing surface, per doz., $1.10.
Wilson, two rubbing surface, per doz., $2.
Saginaw, one rubbing surface, per doz., $1.75.
Crescent, one rubbing surface, per doz., $2.25.
Shamrock, one rubbing surface, per doz., $2.
Rubbing surface of the two latter is solid sheet of zinc, without wood backs.

Lawn Mowers.

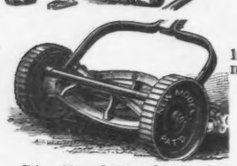
Forward Cut Mowers.

In.	Lbs.		In.	Lbs.	
10	Weight, 30¾	$13.00	16	Weight, 38	$19.00
12 "	31½	15.00	18 "	41	21.00
14 "	36	17.00	21		34.00

Dis. 60 and 5%.

10 in.	12 in.	14 in.
$13.00	$15.00	$17.00
16 in.	18 in.	20 in.
$19.00	$21.00	$23.00

24 in., $30.00.
Geared at both ends.
Dis. 60 and 5 and 5%.



Chadborn & Caldwell Mfg. Co.
10 in. Croquet, 18 pound, mower $11.00
10 in. 13.00
12 in. 15.00
14 in. 17.00
16 in. 19.00
18 in. 21.00
20 in. 23.0
Dis., 60 and 5% and 5% cash 30 days, f.o.b. New York.

New Excelsior Horse Lawn Mower.
25 in. cut, without shafts or seat $65.00
30 " with shaft and seat 110.00
35 " " " " 135.00
40 " " " " 170.00
Horse boots, per set 12.00
Dis. 50%.

Excelsior Three-Blade Mower and Roller.
8 in., $11.00; 10 in., $13.00; 12 in., $15.00; 14 in., $17.00; 16 in., $19.00; 18 in., $21.00; 20 in., $23.00.
Dis. 60% and 5% cash 30 days f.o.b. New York.

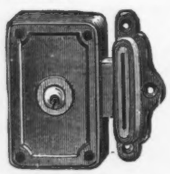
Lemon Squeezers.

THE SAMSON

THE ACME.

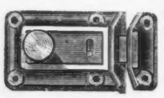
The Acme Lemon Squeezers, knife and squeezer, per dozen, $15.00.
The Samson, per dozen, $3.00.
Porcelain lined, No. 1, per doz. $6.00
25 and 30 % discount.
Wood, No. 2, per doz. $3.00
30 % discount.
Wood, common, per doz. $1.70

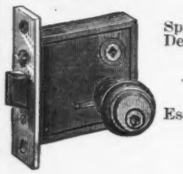
Locks.



YALE PATENT.
RIM STORE LATCH.

	Per doz.
3 × 5 in., 4 keys	$48.00
2½ × 4 in., 3 keys	39.00





RIM NIGHT LATCH.

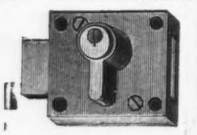
Spring lock, 3 keys	18.00
Dead lock, 3 keys	25.00

NIGHT LATCH.

Escutcheon	39.00
"	36.00

MORTISE DEAD LOCK.

4⅝ × 3½	45.00
2⅜ × 3½	24.00

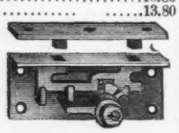


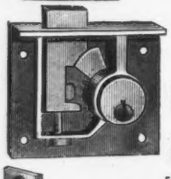
CUPBOARD LOCKS.

Plated Nose	13.20
Brass Nose	12.00

CUPBOARD

Dead Lock	10.80
Spring Lock	13.80





CHEST LOCKS.

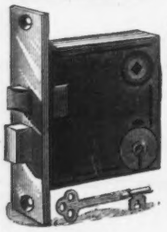
Plated nose	19.20
Brass "	18.00

DRAWER LOCK.

Plated nose	10.20
Brass "	9.00

KNOB LOCKS.

5 × 3⅜	22.50
5 × 3⅜	20.00
4¼ × 3⅜	13.25
3½ × 3⅜	10.50



STANDARD LATCHES.
Dead locks.

3¾ × 2¾	24.00
2½ × 3⅜	14.00
1¾ × 2⅜	12.00

NIGHT LATCHES.

3¼ × 3⅜	20.00
2½ × 3¾	18.00

DRAWER LOCKS.
2 × 1⅝, two tumblers.

Plated nose	7.50
Brass "	6.00

Three tumblers.

Plated nose	9.00
Brass "	7.50

RIM FLUSH DRAWER LOCK.
2 in. diameter.

	2 tumblers.	3 tumblers.
Plated nose	7.50	9.00
Brass "	6.00	7.50

BRONZE SPRING PADLOCK.
2 flat steel keys.

In.	
1	11.00
1¼	12.00
1½	13.50
1¾	14.50
2	16.00
2¼	17.50

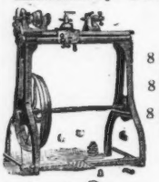
Subject to special net prices; no discount

YALE KEYS.

Lumber.—Soft.

Per 1000 ft.	New York.	Boston.	Per 1000 ft.	New York.	Boston.
Flooring—			Bevel siding—		
4-4 No. 1	$24.00	$26.00	No. 1	15.00	16.00
4-4 " 2	20.00	22.00	No. 2	13.00	14.00
4-4 " 3	17.50	19.50	Base Boards,		
5-4 " 1	26.50	28.50	D. 4 S—		
5-4 " 2	21.00	23.00	4-4 No. 1	26.00	28.00
5-4 " 3	18.50	20.50	4-4 " 1	22.00	24.00
Ceiling—			Stk. Boards, D		
4-4 No. 1	25.00	27.00	2 S—		
4-4 " 2	20.50	22.50	4-4 No. 1	26.50	28.50
5-8 " 1	19.50	20.50	5-4 " 1	28.50	30.50
1-2 " 1	15.75	16.75	6-4 " 1	29.50	31.50
5-8 " 2	15.75	16.75	8-4 " 1	30.50	32.50
1-2 " 2	12.25	13.25	Edge Boards,		
Partition—			D 2 S—		
4-4 No. 1	25.50	27.50	4-4 No. 1	24.50	26.50
4-4 " 2	21.00	23.00	Edge wide, D		
Ger. siding—			2 S—		
4-4 No. 2	25.00	27.00	4-4 No. 1	26.50	28.50
4-4 " 2	21.00	23.00			

Machinery—Foot Power.



S., M. & Co.'s Screw-Cutting Engine Lathes.
8 in. swing, 20 in. bet. centers, 36 in. bed, 240 lbs. weight, $60.
8 in. swing, 30 in. bet. centers, 46 in. bed, 260 lbs. weight, $70.
8 in. swing, 36 in. bet. centers, 52 in. bed, 280 lbs. weight, $75.
Boxing for export, $2.50 extra; f.o.b. at Cincinnati, 25 % dis.

SAWS AND LATHES.

Victor Scroll Saw, Cuts to 3 Inches.
24-inch swing, with 12 saw blades $40
Dis., 20%.

Empire Scroll Saw, Cuts to 3 Inches.
24-in. swing, drill and tilting table.
Price, boxed $25
Dis., 20%

The Acme Combination Saw.
Hand or steam power.
Adjustable table and gauges.

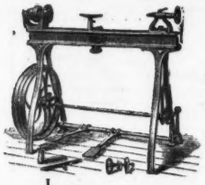
Price, boxed	$40
Scroll saw attachment	7
Boring attachment	10
Moulding attachment	10

Dis., 20%.

Paragon Self Feed Rip Saw.
Two changes of speed; three changes of feed.
Price, with one 10 in. saw, $50.00.
Dis., 20%.

Diamond Mortising Machine.
With mortise ¼ to 1 in. wide, 3 in. deep.
" cut tenons ⅛ to ¾ thick, 3 in. wide.
Price, with 3 chisels $25.00
Dis., 20%.

The "Star" Lathe.
Swings 9 × 25 in., back geared, screw cutting.
Feeds in or out, right or left. Adjustable Tail Stock for Tapers.
Price $75.00
Dis., 15%.



The Crown Lathe.

Swings 10 × 36 in.

Price, boxed..... $45.00
Compound slide rest... 15.00
Countershaft 10.00

Dis., 20%.

Rival Scroll Saw, with six extra saw blades, twist drill and wrench.

Price..... ...$10.00
Lathe attachment..... ....$3.00

Dis., 25%.

The Challenge Scroll Saw, for shell, bone wood, or metal.

Nickel Plated, with six extra saws, twist drill and wrench.

Boxed.....$20.00
With lathe attachment.....$5.00

Dis., 25%.

Hand Circular Rip Saw.

Cuts 3¾ thick, 19 in. wide.

Price $50.00.

Dis., 35%.

Scroll and Circular saw Combined. Combined Machines.

Combined circular scroll saw and boring attachment—2 circular saws, 12 assorted scroll saws, boring attachment, and self-centering drill chuck.....$50.00
Combined circular and scroll saw—2 circular and 12 scroll saws..... 40.00
Circular saw—1 extra rip and 1 cross-cut saw..... 35.00
Scroll saw—12 assorted scroll saws..... 32.00
Counter shaft for steam power..... 10.00

Dis., 35%.

Foot Power Former.

$20.00; Knives extra, $1.00 each.

Dis., 35%.

Mortising Machine.

$22.00; Chisels, $1.00 each.

Dis., 35%.

Blind Slat Chisels, 3 set bits, $5.00.

Dis., 20%.

Tenoning Machine,

Price, $25.

Dis., 35%.

Velocipede Scroll Saw,

Without boring attachment..... $20.00
With " " 23.00

1 doz. saw blades, 1 3-16 bit. } Included.

Dis., 35%.

Lathe.

3 centres, 1 spur, 2 tool rests and sockets, 1 turned face-plate, $35.

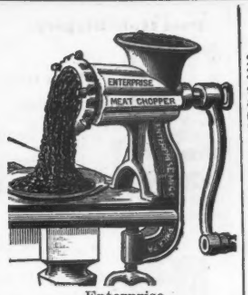
Dis., 30%.

Lathe.

One turned face-plate, two pointed and one spur center, two rests, with sockets and plate for hand tools, slide rest-wrench, belting, etc., $40.

Dis., 25%.

Meat Cutters.



American.

	1	2	3	4
each,	$5.00	7.00	10.00	25.00

Dis., — —.

Enterprise.

	10	12	22	32	42
each,	$3.00	2.50	4.00	6.00	15.00

Dis., 30%.

Mining Machinery.

N. B.—Special attention is invited to the goods advertised and illustrated in the advertising pages of the ENGINEERING AND MINING JOURNAL, quotations and discounts upon which would only mislead buyers.

Price-lists and other information may be obtained by addressing the advertisers direct, or by writing to the ENGINEERING AND MINING JOURNAL.

Mouse Traps.

The Cyclone Mouse Trap, per gross, $4.05.

The Idea Mouse Trap, per gross, $8.25.

Slayer Rat Traps, per gross, $10. Net prices.

Nails and Tacks.

Swedes. Tacks.

Per doz.	½	¾	1	1¼	2	2½	3	4
½ wt..	35	40	46	50	55	60	65	75
	6	8	10	12	14	16	18	20	24 oz.
	85	1.00	1.20	1.40	1.60	1.75	1.85	2.15	2.55
Doz. full weight	½	¾	1	1¼	2	2½	3	4
	60	70	80	90	1.00	1.10	1.20	1.40
	6	8	10	12	14	16	18	20	24 oz.
	1.60	1.90	2.30	2.70	3.10	3.40	3.80	4.20	5.00
lb., bulk	½	¾	1	1½	2	2½	3	4
or paper	1.60	1.25	1.00	80	66	58	52	46
	6	8	10	12	14	16	18	20	24
	36	32	31	30	29	28	28	28	28

Discount, 67½, 10 and 2%.

O. H. Swedes.

Price, same as Swedes.

Swedes steel tacks same list price as iron.

Discounts, 72½, 10 and 2%.

Upholsterers.

Price, same as Swedes.

Cut Tacks. Price per dozen ounces.

	1	1½	2	2½	3	4	6	8	10
¼ wt.....	..	..	..	..	35	40	45	50	55
	12	14	16	18	20				
	60	70	80	90	1.00				
½ wt.....	1	1½	2	2½	3	4	6	8	10
	45	50	50	55	60	65	70	80	95
	12	14	16	18	20				
	1.10	1.25	1.40	1.55	1.70				
Full wt...	1	1½	2	2½	3	4	6	8	
	80	90	90	1.00	1.10	1.20	1.30	1.50	
	10	12	14	16	18	20			
	1.80	2.10	2.40	2.70	3.00	3.30			

Discount, 70, 10 and 2%.

Carpet Tacks, flat and oval heads.

Blued, doz. oz.	4	6	8	10	12	14	16	18	20
¼ wt.	35	40	45	50	55	65	75	85	95
	22	24							
	1.05	1.15							
" ½ wt.	4	6	8	10	12	14	16		
	65	70	80	95	1.10	1.25	1.40		
	18	20	22	24					
	1.55	1.70	1.85	2.00					
Tinned, doz. ¼ wt.	4	6	8	10	12	14	16		
	50	55	60	75	85	1.00	1.10		
	18	20	22	24					
	1.20	1.35	1.45	1.60					
Tinned, doz. ½ wt.	4	6	8	10	12	14			
	95	1.05	1.15	1.40	1.60	1.85			
	16	18	20	22	24				
	2.10	2.35	2.60	2.85	3.10				

Discount, 72½, 10 and 2%.

Finishing Nails.

Inch....	5/8	3½-8	4-8	4½-8	5/8	5½-8	6-8	7-8	1
Per lb...	48	40	32	28	26	24	22	20	18

1½ and larger. 16

Discount, 60, 10 and 2%.

Chair Nails.

Doz. ½ wt.; doz. full wt.; pound B. or P.

Inch..	3/8	3½-8	4-8	4½-8	5/8	5½-8	6-8	7-8
Per lb.	51	43	35	31	29	27	25	23
	1	1¼						
	21	19						

Discount, 60, 10 and 2%.

Common and patent brads.

inch.	Price per doz. ½ wt.	Price per doz. full wt.	Price per lb. in papers or bulk.
2-8.....	.50	1.00	1.25
3-8.....	.60	1.20	.80
4-8.....	.65	1.30	.58
5-8.....	.72	1.44	.48
6-8.....	.80	1.60	.36
7-8.....	.90	1.80	.30
1.....	1.00	2.00	.26
1⅛.....	1.12	2.24	.25
1¼.....	1.26	2.52	.24
1½.....	1.82	3.64	.22
1¾.....	2.25	4.50	.20
2.....	2.43	4.86	.18

Dis. 60, 10 and 2%.

Oars.

Best quality selected White Ash.

	Cents.		Cents.
6 to 12 ft., per sq. ft...	7	22 ft., per sq. ft.....	14
13 " 16 " " " ...	8	24 " " "	18
17 " 18 " " " ...	8½	25 " " "	20
19 " " " ...	10	5 and 2½ cash.	
20 " " " ...	11		

Oils.

LUBRICATING.—Fiske Bros.

Lubroleine A cylinder oil 50 in. barrels.
Lubroleine D cylinder oil 40 in. barrels.
Lubroleine A machine oil 45 in. barrels.
Lubroleine B machine oil 35 in. barrels.
Lubroleine A engine oil 50 in. barrels.
Lubroleine B engine oil 40 in. barrels.
In cases 5c gal. extra.

Crescent Axle Grease.—Barrels, 3c per lb; 100-lb. kegs, 3½c lb.; 2-lb. decorated tins, $12, gross less 5 per cent.

Texas Star Axle Grease.—Barrels, 2½c per lb.; 100-lb. kegs, 3c per lb.

Oil Stones.

Best White Washita.

Green Paper Brand, 8 × 2 × 1¼ inches.....per lb.	.32
Oil stone, No. 1, " " ..... "	.22½
" Extra, " " ..... "	.30
High rounds, " " ..... "	.30
Round edge slips, Nos. 1, 3½ to 5, in boxes 10 lbs. upwards..... "	.40
Round edge slips, extra, in boxes 10 lbs. upwards..... "	.50
Pen knife pieces, ass't 3 to 5 × 1 × 1⅜, in boxes 10 lbs. upwards..... "	.50
Needle pieces.....per hundred.	$5.00
Wheels, 1½ to 5¾ in. thick.....per inch.	.40

Good Washita,

Oil Stone No. 1, 8x2x1½.....per lb.	.15
" " 2, " ..... "	.12
Axe Stone, assorted sizes..... "	.10
Round Edge Slips, assorted sizes..... "	.25

Arkansas.

Oil Stone No. 1, 4 to 6 in. long x2x¾ to 1 in. per lb.	$1.35
Oil Stone No. 1, 6 to 9 in. long x2x¾ to 1 in. "	1.75
Oil Stone No. 2, 4 to 9 in. long x2x¾ to 1 in. "	.75
Round Edged Slips, assorted sizes ..... "	2.00
Square File Slips, 3 to 4 inches long.....per doz.	1.75
Diamonds, 3½ to 4 inches long..... "	3.00
Triangulars, 3½ to 4 inches long..... "	3.00
Flat Files, 3 to 4 inches long..... "	2.00
Beveled Files, 3½ to 4 inches long..... "	2.50
Knife Blades, 3 to 4 inches long..... "	3.00
Points, extra long, 3 to 3½ inches..... "	2.00
Points..... "	1.50
Pen Knife Pieces, assorted sizes.....per lb.	2.00
Needle Pieces.....per hund.	8.00
Wheels, 2 to 4 inches, ½ inch thick.....per inch	1.25
Oil Stone Powder.....per lb.	15

10, 10 and 2½ dis.

Oil Stoves.

Burns 8 hours; holds 1 quart oil.

Nickel plated crown plate, per doz $12.

Packings. (See also India Rubber Goods, page 6.)

SHELDEN'S PATENT.

For Steam, Air, Water and Ammonia.
With Rubber Core, 60 cents per lb.
Dis., 25 and 5%.
With canvas core, 50 cents per lb.
Dis., 30 and 5%.

Patent Link Belting.

Link-Belt Machinery Co.'s. Price per running foot net.

No.	Price.	No.	Price.
25.....	$0.13	78.....	$0.40
32.....	.13	83.....	.45
33.....	.12	85.....	.50
34.....	.13	88.....	.50
35.....	.14	95.....	.60
42.....	.16	103.....	.75
45.....	.16	105.....	.70
51.....	.20	106.....	.90
52.....	.25	107.....	.80
55.....	.22	108.....	.80
57.....	.24	109.....	.90
62.....	.30	114.....	1.10
66.....	.30	122.....	1.50
67.....	.30	124.....	1.30
73.....	.35	146.....	1.40
77.....	.35		

Sprocket wheels..... 25%

(Rubber belting, see page 6.)

Paints.

For Assorted Cans of 1, 2, 3 and 5 pounds. 100-lb. cases.

No.	lb. c.	No.	lb. c.
533. Scotch yellow.....	18	583. Black	18
534. Lead color.....	18	584. Dark blue.....	25
536. Brown	18	585. Chrome yellow.....	30
537. Light drab.....	18	586. Vermilion.....	30
539. Buff.....	18	587. Indian red.....	25
542. Warm drab.....	18	588. Bronze green.....	25
544. Dark green.....	25	589. Quaker green	25
581. Light green.....	25	546. Inside white.....	18
582. Norway red.....	18	547. Outside white.....	18

Discount 50 per cent.

Ordinary shades. Per gal.			Per gal.
One to 5 gallon cans..	$1.90	Half gallon cans.....	$2.00

Tuscan Red, Green and Yellow.

Per gal.			Per gal.
One to 5 gallon cans..	$3.10	Half gallon cans.....	$3.30

Vermilion.

Per gal.		Per gal.
One to 5 gallon cans.. $5.00	Half gallon cans	$5.20

Discount 40 per cent.

The list in barrels, half-barrels and kegs (of 5 gallons or larger) will be 10c. a gallon less than in gallon cans. Kegs of less than 5 gallons will be charged at gallon price. One-quarter gallon cans not put up. Special shades made to order.

Special cash discount for large orders.

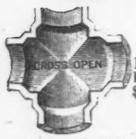
Pipe Covering.

Magnesia Sectional Covering.

For Wrought Iron Pipe. In Canvas Jacketed Sections, 36 inches in length.

Inside dia. of pipe.	Weight of cover per lineal ft.	Price per lineal foot canvas jacketed.
⅛ in.	8 ozs.	$0.25
¾ "	9 "	0.25
1 "	10 "	0.25
1¼ "	12 "	0.25
1½ "	15 "	0.25
2 "	18 "	0.27
2½ "	20 "	0.31
3 "	24 "	0.36
3½ "	26 "	0.40
4 "	30 "	0.44
4½ "	38 "	0.47
5 "	40 "	0.50
6 "	48 "	0.60
7 "	55 "	0.65
8 "	65 "	0.75
9 "	75 "	0.80
10 "	85 "	0.90

Elb'ws.	Tees.	G Valv's.	Crosses.	Unions.
$0.20	$0.30	$0.25	$0.35	$0.30
0.25	0.33	0.25	0.43	0.33
0.25	0.33	0.25	0.43	0.33
0.25	0.33	0.25	0.43	0.33
0.25	0.33	0.25	0.43	0.33
0.27	0.36	0.27	0.48	0.33
0.31	0.41	0.41	0.53	0.41
0.36	0.48	0.48	0.60	0.48
0.40	0.53	0.53	0.68	0.53
0.44	0.59	0.59	0.75	0.59
0.50	0.65	0.65	0.80	0.63
0.58	0.75	0.75	0.90	0.67
0.65	0.90	0.90	1.00	0.77
0.83	1.20	1.20	1.10	0.90
1.00	1.35	1.35	1.20	1.00
1.10	1.50	1.50	1.35	1.10
1.25	1.75	1.75	1.50	1.25



Magnesia Plastic Covering (dry)—Prepared Carbonate Magnesia and Fiber, for Trowel Work per barrel, $8.00

Dis. 25%.

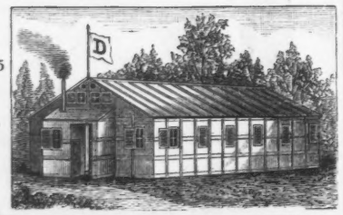
Portable Houses. (Ducker Portable House.)

Weight, 450 lbs.

Price, $150.

Closes securely.

Dis., 10%.



Weight, 85 lbs. per section.

Price, $220.

Dis., 10%.

Weight, complete, 5000 pounds.

No. 10.—26 × 33 ft.. including veranda and rear extension. Main part, 19 × 26 ft.....$500.00

	No. 1. Veranda on side.	No. 2. Veranda on end.	No. 3. without veranda.
12 × 12, 1 door, 3 windows,	$120.00	$120.00	$105.00
12 × 14, 1 " 3 "	135.00	130.00	120.00
12 × 17, 1 " 3 "	155.00	150.00	135.00
12 × 19, 2 " 4 "	175.00	165.00	150.00
12 × 21, 3 " 5 "	190.00	180.00	165.00
12 × 23, 3 " 5 "	200.00	190.00	175.00
12 × 26, 3 " 5 "	220.00	205.00	190.00
14 × 21, 3 " 5 "	205.00	195.00	180.00
10 × 12, 1 " 3 "		100.00	90.00
10 × 14, 1 " 3 "		105.00	95.00
7 × 10, 1 " 2 "			65.00
7 × 12, 1 " 2 "			75.00
7 × 14, 1 " 2 "			85.00

Hunter's Cabins.

7 × 12, with 4 berths	$80.00
7 × 14, " 4 "	90.00

Discount, 20%.

Post Hole Diggers.

Little Giant.....	$36.00	doz 11 cu ft.
Hercules.....	30.00	" " " "
New Champion....	20.00	" " " "
Scheidler.....	36.00	" " " "

Dis. 40% f.o.b. New York or Boston.

Press.

Combined press for cutting, forming, horning and seaming.

Particulars of flat front presses, including beds, slides, bolsters, plates, etc.

Prices are net, delivered on steamers in New York, including insurance, etc.

Nominal size of press	41	42	43	44	45
Price, including et ceteras	$130	$200	$260	$420	$660
Weight, about.....lbs	600	1050	1900	3600	7200
Greatest diameter that can be wired.....ins	5	7	10	14	20
Greatest depth that can be wired.....ins	8	10	13	16½	20
Hole through bed—circle intersecting.....ins	4½	6	8½	12	17
Hole through back—width.....ins	8	9½	12	15½	20½
Width between die clamps—clear.....ins	8	11	15	20	27
Distance back from center of slide bar.....ins	4½	5½	7	9	12
Height to slide-bar, when up..ins	5¼	6½	7½	8½	9
Stroke of slide-bar.....ins	1	1¼	1½	1¾	2
Adjustment of slide-bar.....ins	1	1¼	1½	1¾	2
Diameter of fly-wheel.....ins	20	26	32	38	44
Width of fly-wheel.....ins	3	4	5	6	7
Weight of fly-wheel, about....lbs	125	250	420	725	1100
Speed per minute, about.....rev	120	110	100	90	80
Cubic feet boxed, about.....	30	40	50	60	70

Printers' Sundries.

Vanderburgh, Wells & Co.

Wood rules, 12 cents per yard.

Wood rules, on end wood, 15 cents per foot.

EUREKA STAND.

12 full cases.

Price without cases.....$12.00

Boxing and cartage..... 1.25

CASE RACKS.

	In. High.	Plain.	Inclosed sides and back.
Single, to hold 12 cases,	41¼	$6.00	$8.50
" " 16 "	50¾	7.00	9.50
" " 20 "	60¼	8.00	11.00
" " 24 "	69¾	9.00	12.00
" " 30 "	84	10.00	13.50
Double, to hold 32 "	50¾	12.50	16.00
" " 40 "	60¼	14.00	17.50
" " 60 "	84	18.00	23.00

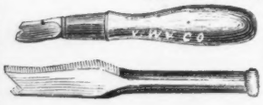
When required we make inclosed case racks trimmed with moldings, and painted or grained. Locking bars, to prevent cases from being removed, furnished to order.

GALLEY RACKS.

8 in., 5 ft. high	$3.00
10 " 5 ft. 8½ in. high	3.50
12 " 6 ft.. 7 in. high	4.25
15 " 8 ft. high	5.25
20 " 9 ft. 8 in. high	7.00

Arms, per pair, 35 cents.

SHOOTING STICKS.



Each.

No. 1, 75c.

No. 2, $1.

No. 4, 45c., black.

No. 4, 60c., bright.

No. 5, 60c., black.

No. 5, 75c., bright.

GAUGE PINS.

Improved brass gauge pins, 40c. doz., all sizes.
Improved wire gauge pins, 25. doz., all sizes.
Improved steel gauge pins, 60c. doz., all sizes.
Improved golden gauge pins, 40c. doz., all sizes.

MITRE BOXES.

Regular size, 2 in., 50c. each.
Extra size, 3½ in., 75c. each.

LEAD CUTTER.

Curtis' Lead Cutter.....$2.00

PROOF PRESS, "OUR OWN,"

9 × 32, complete, with Brayer.....$28.00

TYPE CASES, Full Size.

No.		Strong slat.
1	—Pairs (News).....	per pair, $1.75
3	—German.....	" 1.75
4	—Music.....	" 3.50
4½	—Music.....	" 3.50
5	—Greek.....	" 3.50
6	—Hebrew.....	" 3.50
7	—Job (Italic).....	each 1.00
7½	—New York Job.....	" 1.00
8	—Triple.....	" 1.00
8½	—Paterson Job.....	" 1.00
9	—Yankee Job.....	" 1.00
10	—Lead, No. 1.....	" 1.00
11	—Lead, No. 2.....	" 1.00
12	—Lead, No. 3.....	" 1.00
13	—Quad, No. 1.....	" 1.00
13½	—Quad, No. 2.....	" 1.25
14	—Labor Saving Rule, No. 1.....	" 1.20
15	—Labor Saving Rule, No. 2.....	" 1.20
16	—Labor Saying Rule, No. 3.....	" 1.20
17	—Slug.....	" 1.00
18	—Border.....	" 1.00
19	—Blank or Cut.....	"
19½	—Improved Wood Type.....	"
20	—Sort, No. 1, extra deep.....	" 1.50
41	—Sort, No. 2, extra deep.....	" 1.50

PROOF GALLEYS.

All Wood.

Single column, 4⅛ × 25 inches inside	$0.80
Double " 7 × 25 " "	90

Brass Bottom.

Single column, 3⅜ × 23¼ inches inside	$1.25
Double " 6¾ × 23¼ " "	1.50

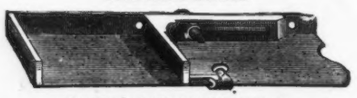
Half Lined.

Single column, 3⅜ × 23¼ inches inside	$1.76
Double " 6¼ × 23¼ " "	2.25

All Brass.

Single column, 3¾ × 23¾	$2.50
Double " 6¼ × 23½	3.00

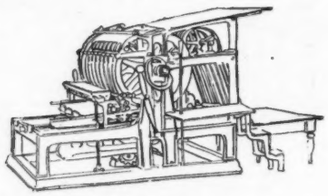
COMPOSING STICKS.



GROVER'S PATENT AND UNION.

	Screw or News.
6 in., 1.10	$ .75
8 " 1.20	.80
10 " 1.40	1.00
12 " 1.60	1.15
14 " 1.80	1.30
16 " 2.00	1.45
18 " 2.20	1.60
20 " 2.40	1.75

Composing rules, 14 ems pica and under, 25 cents.



THE "LIBERTY" CYLINDER PRESS.

For Newspaper and Job Printing.

	Bed. Form.	
No. 5	29 × 42 24 × 40	$1,200
6	33 × 47 28½ × 45	1,300
7	37 × 51 33 × 49	1,600

Dis., 20 and 5%.

THE "LIBERTY" JOB PRINTING PRESS.

Size of chase.

No. 2	— 7 × 11	$200
2a	— 9 × 13	250
3	—10 × 15	300
3a	—11 × 17	350
4	—13 × 19	400
5	—14½ × 22	500

Dis., 12½ and 5%.

Two sizes built extra strong for boxmakers, embossing, etc.

No. 3a	—11 × 17	$375
4	—13 × 19	425

Dis., 12 and 5%.

Fountains, either size, $25 extra, if ordered with press.

Steam fixtures, either size, $15 extra.

THE AMERICAN CARD AND BILL HEAD PRESS.

No. 5—4 × 6	$16
7—6 × 9	36
8—8 × 12	60

Dis., 20% and 5%.

THE "LIBERTY" PAPER CUTTER.

Cuts 30 inches	$140.00
Extra knife	18.80

Dis., 12% and 5%.

THE "LIBERTY" IMPOSING TABLES.

Marble top.

No. 1—24 × 36	$24
2—32 × 48	38
3—26 × 74	44
4—36 × 48	48

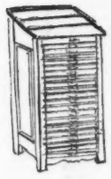
Dis., 12% and 5%.

Slate Top.

No. 1—24 × 36	$18
2—32 × 48	25
3—26 × 74	32

Dis., 12½ and 5%.

THE "LIBERTY" TYPE CABINETS.



Number of cases.	Stained. Flat.	Stained. Galley.*	Grained. Flat.	Grained. Galley.*
	$	$	$	$
12⅜	12.00	14.50	14.00	17 00
16⅜	15.00	17.50	17.00	20.00
18⅜	16.50	19.00	18.50	21.50
20⅜	18.00	20.50	20.00	23.00
12¾	15.00	17.50	17.00	20.00
16¾	18.00	20.50	20.00	23.00
18¾	19.50	22.00	21.50	24.50
20¾	22.00	24.50	23.00	26.00
12 full	18.00	20.50	20.00	23.00
16 "	22.00	24.50	24.00	27.00
18 "	24.00	26.50	26.00	29.00
20 "	26.00	28.50	28.00	31.00

Number of cases.	Pine. Flat.	Pine. Galley.*	Cherry. Flat.	Cherry. Galley.*	Napanoch. Flat.	Napanoch. Galley.*	Walnut. Flat.	Walnut. Galley.*
	$	$	$	$	$	$	$	$
12¾	18.00	21.00	20.00	23.00	22.00	25.00	23.00	26.00
16¾	22.00	25.00	24.00	27.00	26.00	29.00	27.00	30.00
18¾	24.00	27.00	....	....	....	....	....	....
20¾	26.00	29.00	28.00	31.00	30.00	33.00	31.00	34.00
12¾	21.00	24.00	23.00	26.00	25.00	28.00	26.00	29.00
16¾	25.00	28.00	27.00	30.00	29.00	32.00	30.00	33.00
18¾	27.00	30.00	....	....	....	....	....	....
20¾	29 00	32.00	31.00	34.00	33.00	36.00	34.00	37.00
12 full	24.00	27.00	26.00	29.00	28.00	31.00	29.00	32.00
16 "	28.00	31.00	30.00	33.00	32.00	35.00	33.00	36.00
18 "	30.00	33.00	....	....	....	....	....	....
20 "	32.00	35.00	34.00	37.50	36.00	39.00	37.00	40.00

*Furnished with galley top and extra drawer for copy.
Dis., 20 and 5%.

THE "LIBERTY" CASE STANDS AND RACKS.

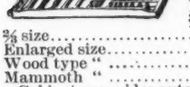
Stands.
Single, without racks ..$3.75
" with racks for 8 full cases..... 4.00
Single, with racks for 10 full cases... 4.25
Single, with racks for 12 full cases..... 4.50
Single, with racks for 14 full cases..... 4.75
Double, without racks... 4.25
" with racks for 8 full cases..... 4.50
Double, with racks for 16 full cases, and gal. rest 6.25
Double, with racks for 20 full cases and gal. rest.... 6.50
" " " " 24 " " " " ... 6.75
" " " " 24 ⅞ cases 5.25
" " " " 8 full and 8 ⅞ cases 5.00
" " " " 8 " " 8 ¾ " 5.25
" " " " 10 " " 12 ⅞ " 5.50
" " " " 12 " " 16 ⅞ " 5.75
" " " " 12 " " 16 ¾ " 6.00
Stands with closed ends, extra..... 2.00
Extra slides for stands, each..... .05

Case Racks.

Cases.	Inches High.	Inclosed Back and Sides. Price.	Cases.	Inches High.	Inclosed Back and Sides. Price.
12	41	$6.00	$8.50	30 84	$10.00 $13.50
16	50	7.00	9.50	32 51	12.50 16.00
20	60	8.00	11.00	40 60	14.00 17.50
24	70	9.00	12.00	60 84	18.00 23.00

Dis., 20 and 5%.

THE "LIBERTY" TYPE CASES.



Name.	Outside Measurements.
Full size.....	32¼x16½x1 9-16
Rooker size.....	23⅝x14¼x1 9-16
¾ size.....	26x16½x1⅜
⅔ size.....	23⅝x16½x1⅜
Enlarged size.....	32¼x23x2 3-16
Wood type "	32¼x23x1 9-16
Mammoth "	44x23x1 9-16

Cabinet case sides extend 1½ to 3 inches. In ordering cabinet cases, state whether high or low fonts are wanted.

Name.	Without Pat. Clasps.	With Pat. Clasps.
News, full, per pair.....	$1 60	$1.75
" Rooker, "	1.60	1.75
" ¾ "	1.50	1.60
" ⅔ "	1.40	1.50
German, full, "	1 60	1.75
Music " "	2 00	2.20
Job " "	.90	1.00
Job, full size, California.....	.90	1.00
" Rooker.....	.90	1.00
" full, Yankee.....	.90	1.00
" ¾ Regular.....	.80	.90
" ¾ Yankee.....	.75	.85
" ⅔ Boston.....	.75	.85
" " California.....	.75	.85
" " improved	.90	1.00
" full size, Middletown.....	1.20	....
" " Paterson.....	.90	....
" " New York.....	.90	1.00
Quadruple, full size.....	1.20	....
Double lower, "	1.20	....

Name.	Without pat. clasps.	With pat. clasps.
Galley lower, full size.....	$1.10	
Enlarged Yankee job.....	2.20	
Enlarged German.....	2.20	
Founder's sort case.....	2.20	
Half-cap.....	.50	
L. S. lead, full-size.....	1.00	
" rule "	1.15	$1.25
" " ¾ size.....	.95	1.05
" " ⅔ "	.80	.90
Improved, ⅔ "	.90	1.00
Space and quad, full-size.....	1.00	
Slug "	1.00	
Figure "	.90	
Triple "	.90	1.00
Improved triple "	.90	1.00
Triple, ¾ size.....	.80	.90
Blank, full-size	.65	
" ¾ size.....	.55	
" ⅔ size.....	.50	
Script, full-size.....	.90	
" ¾ size.....	.80	
" ⅔ size.....	.75	

Wood type, 23x32¼.....	1.10
Mammoth, 23x44.....	1.30
Metal furniture, full-size	1.25
Border "	1.25
" ⅔ size.....	1.00
Leader, ⅔ size, per pair.....	1.40
Butler jobs, full-size, per pair.....	3.00
For pulls on cabinet cases add per case.....	.10
For rollers " " "	.30

Dis., 25 and 5%.

THE "LIBERTY" GALLEYS.
All brass "indestructible."

Single, 3¾ x 23¾ inside.....	$2.50
" 3¾ x 1- ¾ "	2.00
" 3¾ x 11¾ "	1 75
Medium, 5 x 23¾ inside.....	2.75
Double, 6¼ x 23¾ inside.....	3.00

Dis., 33⅓%.

SMOOTH LINED NEWS GALLEYS.

Half-lined.	Full-lined.	Half-lined.	Full-lined.
Single col. $1.75	$2.00	Double col. $2.00.	$2.50

Dis., 20% and 5%.

SCREW GALLEYS.

Unlined.	Half-lined.	Full-lined.
Single column.....$1.25	$1.50	$1.75
Double column..... 1.50	1.75	2.00

Dis., 20% and 5%.

SMOOTH LINED JOB GALLEYS.

Size.	Unlined.	Full-lined.	Size.	Unlined.	Full-lined.
6 × 10	$1.25	$2.00	12 × 18	$2.50	$3.50
8¼ × 13	1.50	2.50	14 × 20	3.00	4.00
9 × 14	1.75	2.75	15 × 22	3.50	5.00
10 × 16	2.00	3.00	18 × 25	4.00	5.50

Dis., 20% and 5%.

RULED GALLEYS.

These have a rule laid out on one of the rims, divided into quarter inches, by which to set advertisements. Cost of ruling extra, 25 cents.
Dis., 20% and 5%.

MAILING GALLEYS.

Zinc bottom, 50 cents; brass bottom, 90 cents. Brass, closed both ends, $3.
Dis., 20% and 5%.

GALLEY RACKS.

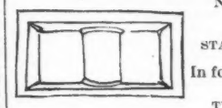
From $3 up.

LEAD CUTTERS.

From $2 up.
Dis., 20% and 5%.

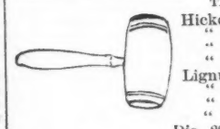
THE "LIBERTY" STEEL SHOOTING STICKS.

Bright, $1 each.
Nickelplated, $1.25 each.
Dis., 40%.



STANDARD METAL FURNITURE

25c. a pound.
In fonts of 25, 50, 75 and 100 lbs.
Dis., 15%.

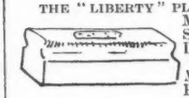


THE "LIBERTY" MALLETS.

Hickory, small.....	$ .20
" medium.....	.25
" large.....	.30
" iron bound.....	1.00
Lignum Vitæ, No. 4.....	.30
" " No. 3.....	.40
" " No. 2.....	.50
" " No. 1.....	.70

Dis., 20 and 5%.

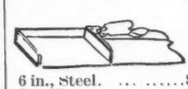
THE "LIBERTY" PLANERS AND PROOF PLANERS.



Midget planer.....	10c.
Small Maple.....	20c.
Large "	25c.
" b'k'd with leather.....	30c.
Midget " " "	12c.
Proof planer, faced with cloth,	50c.

Dis., 40%.

THE "LIBERTY" COMPOSING STICKS.



Grover.

6 in., Steel.	$ .90	16 in., Steel.....	$1.80
8 "	1.00	18 "	2.00
10 "	1.20	20 "	2.20
12 "	1.40	Extra Clasp.....	.10
14 "	1.60	Extra Knee.....	.40

Screw.

6 in., Steel.....	$ .75	16 in., Steel.....	$1.45
8 "	.80	18 "	1.60
10 "	1.00	20 "	1.75
12 "	1.15	Extra Knee.....	.30
14 "	1.30	" Screw and Nut.	.10

Dis., 40%.

Yankee.

6-in., Steel.....	$ .75	12 in., Steel.....	$1.15
8 "	.80	Extra Knee.....	.30
10 "	1.00	" Clamp and Screw	.15

Other Sizes to Order.
Dis., 40%.
Albion.

6-in., Steel.....	$1.00	6-in, German Silver...	$1.50
8 "	1.10	8 " " " ...	1.75
Extra Knee.....	.40	Extra Screw and Nut.	.10

Potato Parer and Corer.

Saml. Lees & Co.

List, $9 per gross.

Pumps.

Rumsey & Co.
Prices on all pumps include cylinders.

No.	Dia. Cyl.	Suction.	Cap. stroke.	Price Iron.	Price Brass cyl.
0	2 in.	1 in.	1-15 gal.	$3.50	.....
1	2¼ "	1 "	1-12 "	4.00	$6.00
2	2⅜ "	1¼ "	1-11 "	4.50	7.00
3	2½ "	1¼ "	1-10 "	5.00	8.00
4	3 "	1¼ "	1-6 "	5.50	10.00
5	3¼ "	2 "	1-5 "	6.50	14.00
6	3½ "	2 "	1-4 "	8.00	18.00
7	4 "	2½ "	1-3 "	12.00	20.00

Dis., 65%.

No.	Dia. Cyl.	Suction.	Cap. stroke.	Price Iron.	Price Brass cyl.
1	2½ in.	1¼ in.	1-10 gal.	4.25	.....
2	3 "	1¼ "	1-7 "	4.75	.....
3	3½ "	1¼ "	1-5 "	5.25	.....
4	4 "	1½ "	1-4 "	5.75	.....
5	4½ "	1½ "	1-3 "	6.25	.....

Dis., 70%.

Standard and Cylinder for 1½ in. Iron Pipe, $16.00.

Dis., 55%.

No. 6½, standard and cylinder, 1¼ in. pipe, $13.00.
No. 7½, standard and cylinder, 1¼ in. pipe, $15.00.
No. 8½, standard and cylinder, 1½ in. pipe, $18.00.
With hose and discharge pipe, add $3.00 to list price.
Dis. 55%.

No. 1, diam. cyl, 2½ in.; cap. stroke. 1-8 gal.; size pipe, 1¼ in. Price, iron, $12.50; brass cyl., $17.50.
No. 2, diam. cyl., 3 in.; cap. stroke, 1-6 gal.; size pipe, 1¼ or 1½ in. Price, iron, $14.50; brass cyl., $18.50.
No. 3, diam. cyl., 4 in.; cap. stroke, 2-5 gal.; size pipe, 1½ or 2 in. Price, iron, $23.50; brass cyl., $34.50.

Dis., 55%.

No. 1, diam. cyl., 3 in.; suction, 1¼ in.; cap. stroke, 3-10 gal. Price, iron, $28.00; brass cyl., $38.00.
No. 2, diam. cyl., 4 in.; suction, 1½ in.; cap. stroke, 1-2 gal. Price, iron, $32.00; brass cyl., $60.00.
No. 3, diam. cyl., 5 in.; suction, 2 in.; cap. stroke, 6-7 gal. Price, iron, $35.00; brass cyl., $90.00.
No. 4, diam. cyl., 6 in.; suction, 2½ in.; cap. stroke, 1 1-5 gal. Price, iron, $45.00; brass cyl., $120.00.

Dis., 45%.

No.	Diam. cyl.	Cap. stroke.	Stroke.	Pipe.	Price.
0	2 in.	1-11 gal.	7 in.	1 in.	$21.50
00	2½ "	1-7 "	7 "	1¼ "	23.00
1	3 "	1-5 "	7 "	1½ "	25.25
2	3½ "	1-3 "	7 "	1½ "	27.25
3	4 "	4-10 "	7 "	2 "	30.50
3½	4½ "	1-2 "	7 "	2 "	37.50
4	5 "	8-10 "	10 "	2½ "	44.00
4½	5½ "	1 "	10 "	2½ "	47.00
5	6 "	1 1-5 "	10 "	3 "	50.00

Dis., 40%.

No.	Diam. cyl.	Cap. stroke.	Diam. pipe.	Price. Iron.	Price. Br's cyl.
1	2 in.	1-5 gal.	1 in.	$39	$51
2	2½ "	1-3 "	1¼ "	41	56
3	3 "	1-2 "	1½ "	45	62
4	3½ "	6-7 "	2 "	51	81
5	4 "	7-8 "	2 "	63	114
6	4½ "	1 "	2 "	80	155

Dis., 40%.

With Tight and Loose Pulleys.

No. 1, cap. per rev., 1-6 gal.; size of pipe, 1¼ in.; price, iron, $26; bronze, $45.
No. 2, cap. per rev., 1-5 gal.; size of pipe, 1½ in.; price, iron, $31; bronze, $55.
No. 4, cap. per rev., 1-3 gal.; size of pipe, 2 in.; price, iron, $48; bronze, $75.
Pulleys on Nos. 1 and 2 are 8 in. diam., 2½ in. face; on No. 4, 12 in. diam., 3½ in face.
Balance wheels for above pumps. $1, $2, and $3, according to size.

Dis., 45%.

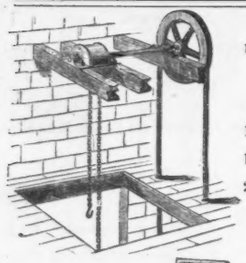
No. 2, ½ to 2 gal. per min.; length of drive pipe, 25 to 40 ft.; calibre of pipes, drive, ¾ in.; discharge, ⅜ in.; price, $9.
No. 3, 1 to 4 gal per min.; length of drive pipe, 25 to 40 ft.; calibre of pipes, drive, 1 in.; discharge, ⅜ in.; price, $11.
No. 4, 2 to 8 gal. per min.; length of drive pipe, 25 to 40 ft.; calibre of pipes, drive, 1½ in.; discharge, ½ in.; price, $14.
No. 5, 3 to 14 gal. per min.; length of drive pipe, 25 to 40 ft.; calabre of pipes, drive, 2 in.; discharge, 1 in.; price, $22.
No. 6, 4 to 25 gal. per min.; length of drive pipe, 30 to 40 ft.; calibre of pipes, drive, 2½ in.; discharge, 1¼ in.; price, $40.
No. 7, 8 to 60 gals. per min.; length of drive pipe, 30 to 40 ft.; calibre of pipes, drive, 4 in.; discharge, 2 in.; price, $75.
No. 8, 12 to 120 gal. per min.; length of drive pipe, 30 to 50 ft.; calibre of pipes, drive, 6 in.; discharge, 2½ in.; price, $125.

Dis., 45%.

Pulley Blocks.

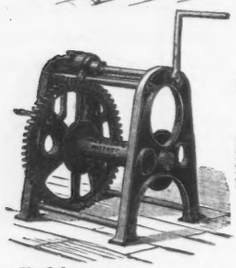
WESTON DIRECT.

	Each.
⅛ ton.....	$10
¼ ton.....	13
½ ton.....	15
1 ton.....	20
1½ tons.....	25
2 tons.....	30
3 tons.....	40
Geared.	
1 ton.....	35
2 tons.....	45
3 tons.....	60
4 tons.....	80
5 tons.....	110
6 tons.....	150
8 tons.....	210
10 tons.....	275



DOUBLE LIFT HOISTS FOR HATCHWAYS, ETC.

500 lbs.	$25.00
1000 "	50.00
1500 "	65.00
2000 "	80.00
500 "	30.00



WESTON CRAB SAFETY BRAKE, HANDLES CANNOT FLY BACK.

	Each.
21	$35.00
22	45.00
23	65.00
25	100.00

Refrigerators.
Indurated Fibre and Stoneware, Lined.
Cordley & Hayes.

No. 35. Nos. 75, 85.

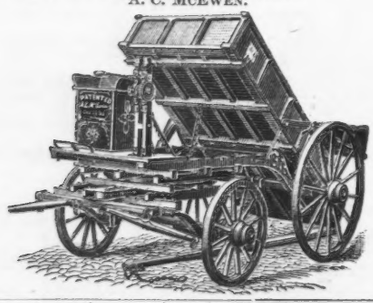
No.	High.	Wide.	Deep.	Price.
35	46¼	28¾	20¼	$20.00
75	44¼	33¼	23½	28.00
85	47¾	38	23½	34.00

No. 2. No. 6.

No.	High.	Wide.	Deep.	Price.
2	41	46	26	$36.00
6	84	46	26	60.00

Mirror 16 by 18 in. Dis., 30 and 5%.

Railroad Dumping Cars and Carts.
A. C. McEWEN.



Cars.	Gauge.	Capacity.	Price.	Capacity.	Price.	Capacity.	Price.
Side Dumping	24"	1 c. y.	$55	2 c. y.	$65	3 c. y.	$75*
End "	"	"	55	"	65	"	75*
Revolving "	"	"	70	"	80	"	90*
Bottom "	"	"	80	"	90	"	100*
Tunnel	"	"	55	"	65	"	75*
Mine	"	"	50	"	60	"	70*
Plantation	30"		43				
Logging	36"		170				
"	4' 8½"		185				
Hand	36"		45				
"	4' 8½"		50				
Push	36"		40				
"	4' 8½"		45				
R.R. Construction	36"		60				
"	4' 8½"		65				
Carts.							
Plantation and Railroad			45 to 75				
Wagons.							
McEwen Patent Dumping		1 "	175	1½ "	200		

*These cars built of any gauge from 18" to 56½" and of any capacity from ½ to 6 cu. yd.

Rules.
"Lufkin." Steel Rules, per doz.

	Rules only.	In leather cases.
No. 31, 1 ft. folding pocket	$4.00	$5.50
" 31, 2 " " "	8.00	10.00
" 41, 1 " " "	4.00	5.50
" 41, 2 " " "	7.50	9.50
" 41, 3 " " "	11.00	13.50
" 41, 4 " " "	14.50	17.00

	1 ft.	2 ft.	3 ft.
No. 60, ¾ × 21 gauge	$4.00	$8.00	
No. 62, 1¼ × 16 "	8.00	15.00	$22.00

Discount, 60 and 10%.
Tinner's Rules.
No. 95, 3 ft. circumference rules ..... each $2.50
No 95, 4 ft. " " " " " 3.00
Discount, in dozen lots, 50%.

	₱ doz.
No. 51, 3½ ft. steel board rules	$42.00
No. 52, 3 " " "	36.00
No. 52½, 2½ ft. " " "	33.00

Discount, 50%.

Sad Irons. (Mrs. Potts' Patent).
With detachable wood handles, in sets of 3 irons, 1 handler, 1 stand (1 each Nos. 1, 2 and 3 iron weighing 4, 5 and 6 pounds respectively.)

	D'ble Pointed. Nickel Plated	D'ble Pointed. Plain P'l'sh'd	Square Back. Nickel Plated	Square Back. Plain P'l'sh'd
No.	150	155	160	165
Price per doz. sets	$30.00	$24.00	$30.00	$24.00
Irons not in sets, either in Nos. 1, 2 or 3, with handles, per doz	12.50	10.50	12.50	10.50
Without handles, per doz	8.50	6.50	.50	6.50
No. 4 iron, extra heavy, weight 7 lbs., with handles, per doz			15.00	15.00
Without handles, per doz			11.00	8.00

Polishing irons with handles.
(Double point.)

	Large size, weight 4½ lbs. each. Nickel Plated	Large size, weight 4½ lbs. each. Plain P'l'sh'd	Small size, weight 3 lbs. each. Nickel Plated	Small size, weight 3 lbs. each. Plaid P'l'sh'd
No.	180	185	182	187
Price per doz.	$15.00	$3.00	$11.00	$9.00

Girls' irons with handles.
Same as No. 1 iron in set, but smaller size. Weight, 2 lbs each.
(Double point.)

Nickel plated. No. 190, per doz	$7.50
Plain polished, No. 195, per doz	6.00
Extra handles for any size, per doz	4.00
Extra stands for any size, per doz	.60

Star Irons,
With Perforated Iron Handle. Not detachable. Assorted either No. 1, 2 or 3 sizes, correspond to the detachable handle irons in sets.

	D'ble pointed Nickel Plated	D'ble pointed Plain Plish'd	Square back. Nickel Plated	Square back. Plain Plish'd
No.	70	75	71	76
Price per doz.	$7.25	$5.50	$7.25	$5.50

Polishing Irons.
Small Size. 3 lbs each. Doubled Pointed.

Nickel Plated.	Plain Polished.
No. 72, per doz. $7.25	No. 77, per doz. $5.50

Girls' Irons.
Double-pointed, 2 lbs. each; similar to detatchable handle irons.
Nickel-plated, No. 100 ..... $5 per doz
Plain polished, No. 105 ..... $3.75 "

Toy Irons.
Weight, 14 ounces each, nickel-plated (No. 110), $3.25 per dozen; plain polished (No. 115), $2.50 per dozen.
Weight, 5 ounces each, nickel-plated (No. 120), $2 per dozen; plain polished (No. 125), $1.05.
Discount on all Sad Irons 50 and 5%.

Sash Chains.

No. A. "Giant" metal, 15c. pr. ft., wts. not over 125 lbs.
No. 1. "Giant" metal, 12c. pr. ft., wts. not over 75 lbs.
No. 2. "Giant" metal, 10c. pr. ft., wts. not over 40 lbs.
No. 0. "Giant" metal, 8c. pr. ft., wts. not over 25 lbs.
No. 1. Red metal, 10c. pr. ft., wts. not over 40 lbs.
No. 2. Red metal, 8c. pr. ft., wts. not over 30 lbs.
No. 0. Red metal, 6c. pr. ft., wts. not over 15 lbs.
No. 1. Steel, 8c. pr. ft., wts. not 75 lbs.
No. 2. Steel, 6c. pr. ft., wts. not over 30 lbs.
No. 0. Steel, 4c. pr. ft., wts. not over 15 lbs.
No. 1. Steel, black enameled, 9c. pr. ft., wts. not over 75 lbs.
No. 2. Steel, black enameled, 7c. pr. ft., wts. not over 30 lbs.
No. 0. Steel, black enameled, 5c. pr. ft., wts. not over 15 lbs.
Fastenings for hanging a window of 2 sashes for Nos. 1 and 2 chains, consisting of 4 hooks, 4 rings, 4 sash irons, a set, 18c. per set.
Fastenings for hanging a window of 2 sashes for No. 0 chains, 14c. per set.

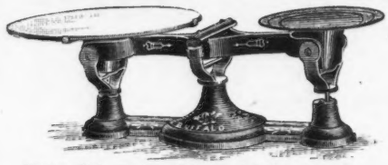
Dis. on				
"Giant" metal chain	40	10	10%	
" " Red metal chain	40	10	10	10%
" " Steel " "	40	10	10	10%
" " Fastenings	40	10	10%	

Scales.—Discount on all scales 50 per cent.
Postal scales.

No 1, capacity ½ to 9 oz., $3.00.
No. 2, capacity ½ to 12 oz., $4.00.
No. 3, capacity ½ to 34 oz., $6.00
No. 4, capacity ½ oz. to 4 lbs., $8.00

Even balance trip scales seamless scoop, with weights.

No. 1, capacity ½ oz. to 2 lbs., tin scoop, $5.50; brass scoop, $6.50.
No. 2, capacity ½ oz. to 4 lbs., tin scoop, $6.50; brass scoop, $7.50.
No. 2½, capacity ½ oz. to 18 lbs., tin scoop, $11; brass scoop, $12.50.



Butter Trip Scales, slab, weights and scoop.

No. 7, ½ oz. to 10 lbs.,	10 in. slab,	without side beam	$10.50
" " " "	" "	with "	11.50
" 8 " " 20 lbs.,	12 in. "	without "	12.50
" " " "	" "	" "	13.50

Tea Scales—All Seamless Scoops.

Capacity.	Scoop.	Capacity.	Scoop.
¼ oz. to 10 lbs.	Tin ..$8.00	¼ oz. to 10 lbs.	Brass ..$9.00

Druggists.

Capacity.	Scoop.	Capacity.	Scoop.
1-16 oz. to 8 lbs.	Tin ..$10.00	1-16 oz. to 8 lbs.	Brass..$11.00

Counter.

Capacity.	Scoop.	Capacity.	Scoop.
½ oz. to 36 lbs.	Tin ..$10.00	½ oz. to 36 lbs.	Brass..$12.00

Grocer.

Capacity.	Scoop.	Capacity.	Scoop.
½ oz. to 62 lbs.	Tin... $12.00	½ oz. to 62 lbs.	Brass..$14.00

Meat or Butter Scales, with Slab.
½ oz. to 62 lbs., with Single Beam $14.00
" " " " Double " 15.00

Patent Boston platform, 13½ in. long by 10 in. wide.

Pillar, 18 in. high, double beam, marked both sides.

With large seamless tin scoop, $25.00
" " " brass " 27.00

Platform scales.—Without Wheels.

No.	Capacity.	Platform.	Price.
1	400 lbs.	21½ by 15 inches.	$23.00
2	600 lbs.	25 by 16 "	30.00
3	800 lbs.	25 by 17 "	34.00
4	1,000 lbs.	26 by 17 "	39.00
5	1,200 lbs.	28 by 20 "	45.00
6	1,600 lbs.	29 by 21 "	55.00
7	2,000 lbs.	32 by 23 "	70.00

With Wheels.

No.	Capacity.	Platform.	Price.
1	400 lbs.	21½ by 15 inches.	$26.00
2	600 lbs.	25 by 16 "	33.00
3	800 lbs.	25 by 17 "	38.00
4	1,000 lbs.	26 by 17 "	43.00
5	1,200 lbs.	28 by 20 "	49.00
6	1,600 lbs.	29 by 21 "	60.00
7	2,000 lbs.	32 by 23 "	75.00

Brass sliding poise at same price if so specified in order.

With Wheels and Drop Lever.

No.	Capacity.	Platform.	Price.
4	1,000 lbs.	26 by 17 inches.	$51.00
5	1,200 lbs.	28 by 20 "	59.00
6	1,600 lbs.	29 by 21 "	70.00
7	2,000 lbs.	32 by 23 "	82.00
8	2,500 lbs.	33¼ by 24¾ "	94.00
9	3 000 lbs.	38 by 30 "	125.00

School Slates.

Noiseless School Slates.
Winsboro Cord Bound.

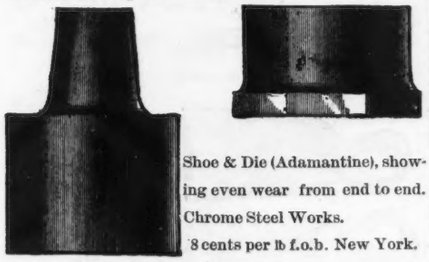
Size.	Doz. in case.	Price per case.
5 by 7	18	$18.00
6 by 9	12	15.00
7 by 11	10	14.40
8 by 12	8	14.00
9 by 13	6	12.00

Dis., 50 and 2½%.
"D" School Slates.
Winsboro Oval Round Corner.

	Doz. in case.	Price per case.
4 by 6	24	$10.80
5 by 7	18	9.00
6 by 8	12	8.20
6 by 9	12	8.64
6½ by 10	12	9.00
7 by 10	10	7.70
7 by 11	10	8.00
8 by 12	8	8.00
9 by 13	6	7.20

Dis., 200 case lots, 50 and 2½%.

Stamp Head Shoes and Dies.



Shoe & Die (Adamantine), showing even wear from end to end.

Chrome Steel Works.

8 cents per lb f.o.b. New York.

Screws.

STEEL SCREWS ADD 50% TO LIST.

Prices are per 100.

Hexagon Cap Screws.

Heads on Steam-tight Screws not polished, unless so ordered. Can make these 12 inches long.

Diam. head.	7-16	½	9-16	⅝	¾	13-16	⅞	1	1⅛	1¼	1⅜
Length head.	¼	5-16	⅜	7-16	½	9-16	⅝	¾	⅞	1	1⅛
Diam. screw.	¼	5-16	⅜	7-16	½	9-16	⅝	¾	⅞	1	1⅛
¾	3.00	3.25	3.75	4.40	5.50	7.00					
1	3.25	3.50	4.00	4.70	5.70	7.00	9.50				
1¼	3.50	3.75	4.25	5.00	6.00	7.50	9.50	12.20			
1½	3.75	4.00	4.50	5.30	6.30	8.00	10.00	12.20	16.00		
1¾	4.00	4.25	4.75	5.60	6.60	8.50	10.60	12.80	16.60	21.20	
2	4.25	4.60	5.05	5.95	7.00	9.10	11.20	13.40	17.20	22.30	29.00
2¼		5.00	5.40	6.35	7.50	9.70	11.90	14.10	17.90	23.60	30.50
2½			5.80	6.80	8.00	10.40	12.70	14.90	18.80	25.10	32.30
2¾				7.30	8.60	11.20	13.60	15.90	20.00	26.90	34.40
3					9.30	12.10	14.70	17.00	21.80	29.00	37.00
Threads to in.	20	18	16	14	12	12	11	10	9	8	7
Add for each ¼ in.	30	40	50	60	80	1.00	1.30	1.60	2.00	2.40	3.00

Length under head.

Dis., heads ground, 60%; dis., heads black, 60 and 5%; dis., heads extra finish, 50%; dis., heads case-hardened, 55%; dis., heads polished after hardening, 45%.

SQUARE CAP SCREWS.

Diam. head.	⅜	7-16	½	9-16	⅝	11/16	¾	⅞	1⅛	1¼	1⅜
Length head.	¼	5-16	⅜	7-16	½	9-16	⅝	¾	⅞	1	1⅛
Diam screw.	¼	5-16	⅜	7-16	½	9-16	⅝	¾	⅞	1	1⅛
¾	2.40	2.75	3.20	3.80	4.40	5.75					
1	2.60	2.95	3.40	4.00	4.70	5.75	7.70				
1¼	2.75	3.10	3.65	4.20	4.95	6.05	7.70	10.50			
1½	2.90	3.30	3.85	4.45	5.25	6.35	8.25	10.50	14.00		
1¾	3.05	3.50	4.10	4.70	5.55	6.65	8.80	11.10	14.80	18.00	
2	3.25	3.70	4.35	4.95	5.90	7.05	9.40	11.80	15.70	19.00	22.50
2¼		4.00	4.65	5.25	6.30	7.55	10.10	12.60	16.70	20.20	24.00
2½			5.00	5.60	6.75	8.15	10.90	13.50	17.80	21.50	25.80
2¾				6.00	7.25	8.85	11.80	14.60	19.10	23.10	27.90
3					7.80	9.65	12.80	15.90	20.60	25.00	30.50
Thread to in.	20	18	16	14	12	12	11	10	9	8	7
Add for each ¼ in.	25	35	45	55	65	90	1 20	1.50	1.80	2.30	3.00

Length under head.

Dis., heads ground, 65%; dis., heads black, 65 and 5%; dis., heads extra finish, 55%; dis., heads case hardened, 60%; dis., heads polished-hardened, 50%.

MILLED HEADS, COLLAR SCREWS.

Diameter of Collar.	¼	11/32	7/16	½	⅝	11/16	13/16	15/16	1	1¼
Diameter of Screw.	⅛	3/16	¼	5/16	⅜	7/16	½	9/16	⅝	¾
¾	2.50	2.80	3.10	3.75	4.40	5.00	6.25			
1	2.80	3.10	3.40	4.05	4.70	5.30	6.60	8.25		
1¼	3.10	3 40	3.70	4.35	5.00	5.60	7.00	8.60	11.25	
1½	3.45	3.70	4 00	4.70	5.30	5.95	7.40	9.00	11.90	15.00
1¾		4.05	4.35	5.05	5.65	6.35	7.80	9.45	12.60	15.60
2			4.70	5.45	6.25	6.85	8.40	10.00	13.35	16.25
2¼				5.95	6.85	7.40	9.00	10.60	14.15	17.10
2½					7.50	8.10	9.60	11.25	15.00	18.00
2¾						8.75	10.30	11.90	15.90	19.00
3							11.00	12.60	16.85	20.00
Threads to inch	40	30	20	18	16	14	12 or 13	12	11	10
Add for each ¼ inch	30	40	50	60	80	1.00	1.30	1.60	2.00	2.40

Length under Head to Point.

Dis., 25%.

MILLED FROM SOLID BAR.

Fillister.

Bevel Head.

Button Head.

Diam. Head	3-16	¼	⅜	7-16	9-16	⅝	¾	13-16	⅞	1
Length Head	⅛	3-16	¼	5-16	⅜	7-16	½	9-16	⅝	¾
Diam. Screw	⅛	3-16	¼	5-16	⅜	7-16	½	9-16	⅝	¾
¾	2.00	2.25	2.50	3.00	3.50	4.00	5.00			
1	2 25	2.50	2.75	3.25	3.75	4.25	5.30	6.60		
1¼	2.50	2.75	3.00	3.50	4.00	4.50	5.60	6.90	9.00	
1½	2.75	3.00	3.25	3.75	4.25	4.75	5.90	7.20	9.50	12.00
1¾		3.25	3.50	4.00	4.50	5.00	6.20	7.50	10.00	12.50
2			3.75	4.36	5.00	5.50	6.75	8.00	10.75	13.00
2¼				4.75	5.50	6.00	7.25	8.50	11.50	13.75
2½					6.00	6.50	7.75	9.00	12.00	14.50
2¾						7.00	8.25	9.50	12.75	15 25
3							8.75	10.00	13.50	16.00
Threads to inch.	40	30	20	18	16	14	12	12	11	10

Length under Head.

Head or Bevel and Button Head Screws, 1-16 larger in diameter than above specifications.

Price, according to size of head.

Discount, 50%; case hardened, 45%; case hardened and polished, 35%.

Slate Roofing.

F. o. b. New York. Stowage allowed.

Purple and Green, per 100 feet sq.....$4.50
Dark blue, per 100 feet sq..... 4.10
Sizes, 24 × 12 = 115 to sq., 650 lbs. weight.
Sizes, 20 × 10 = 170 to sq., 650 lbs. weight.

Shears. The Patent "Eureka."

No. 1 cuts round metal up to ¼ in., steel to ⅛, $12.

No. 2 cuts round metal up to ½ in., steel to 3-16, $20.

Discount, 25%.

Soups (French). Franco-American Brand

	Per dozen. In Cans—Quarts.	Pints.	In Glass. 1½ pt.
Green turtle....	$8.00	$4.32	$9.00
Terrapin.....			
Chicken.....	3.75	2.25	
Mulligatawny..			
Mock turtle.....			
Ox tail.....			4.50
Consommé.....			
Tomato.....			
Julienne.....			
Printanier.....	3.50	2.10	
French bouillon.....			
Mutton broth.....			None in glass.
Vegetable.....			
Beef.....			
Pea.....			

Packed in cases of..... 2 doz. 4 doz. 1 doz.

Regular Assorted Cases. In Cans—Quarts.
2 Chicken, 1 Mulligatawny, 3 Mock Turtle, 3 Ox Tail, 2 Consommé, 2 Tomato, 3 Julienne, 1 Printanier, 1 Mutton Broth, 1 Vegetable, 1 Beef, 2 French Bouillon, 2 Pea. Per doz., $3.55.

In Glass.
11 Chicken, 1 Mulligatawny, 2 Mock Turtle, 1 Ox Tail, 2 Consommé, 2 Tomato, 1 Julienne, Printanier, 1 Mutton Broth.

Terms cash Discounts: 5% for lots of 10 cases, 10% for lots of 25 cases. 15% for lots of 50 cases.

Spades and Shovels.

The D. F. Jones Mfg. Co., of Gananoque (Ld.).

JONES'

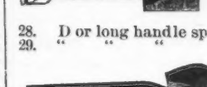
Patent plain black solid cast-steel shovels and spades.

Meyer's patent steel shovel.

No.		Per Doz. No. Black.	Per Doz. Pol's'd
20.	D. or long handle sq.-point shovels. 2	$15.50	$16.50
21.	" " " " " 3	16.25	17.25
22.	" " " " " 4	17.00	18.50
23.	" " " " " 6	17.50	19.00
24.	" " " " charcoal. 8	20.50	22.00

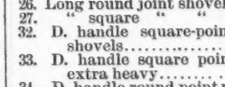
Pt. plain back solid cast steel shovel.

25.	D or long handle round-point shovels. 3	16 25	17.25



Patent steel spade.

28.	D or long handle spades..... 2	16.00	17.00
29.	" " " " 3	16.50	18.00



Patent plait back solid cast steel.

26.	Long round joint shovel No. 2.....	15.50	16.50
27.	" square " " No. 2.....	15.50	16.50
32.	D. handle square-point molders' shovels..... 2	.....	17.00
33.	D. handle square point railroad, extra heavy..... 2	15.75	
34.	D. handle round point railroad, extra heavy 3	16.50	
35.	L. handle round point shovel, with foot cap..... 2	16.00	17.00

GRAY'S

Patent plain back solid-steel shovels and spades.

50.	D. or long handle sq.-point shovels. 2	$12.00	$13.00
51.	" " " " " 3	12.75	14.00
52.	" " " round point " 3	12.75	14.00
55.	D. handle spades..... 2	12.25	13.25
56.	" " " 3	13.00	14.25

Patent solid corrugated scoop.

SCOOPS.

Jones' patent plain back solid corrugated scoops.

90.	D. or long handle solid cast steel...2	$13.50	$14.50
91.	" " " " " ...4	14.50	15.50
91½.	" " " " " ...6	16.50	17.50

Jones' riveted scoops.

92.	Cast steel D. or long handle... 2	13.50	14.50
93.	" " " " 4	14.50	15.50
94.	" " " " 6	16.50	17.50
		Half polished.	
95.	" " " 8		$20.00
96.	" " " 10		22.50
97.	" " " Locomotive or coal (heavy).....6	17.50	
98.	" Long or D. handle for salt (heavy).....6	17.50	
99.	" D. handle flour and house furnace.....	10.50	
100.	" D. handle r'd-pt. for coal (extra heavy).....6	20.00	
		Polished.	
101.	" ash pit, furnace L. handle.....2		13.00
102.	" " " 32 in. D..2		13.50
103.	" " " 42 " iron D. handle.....2		14.00

Ditching spade.

124.	D handle ditching (flat).....	18.00	19.50
125.	D handle post hole (concave).....	18.00	19.50
126.	D handle Alcock (for clay and brick)....	16.00	17.00

Discount on shovels and spades, 50 and 10.
" " " scoops, 50.

Boxed f.o.b. New York, Boston on Montreal.

The solid shovels, spades and scoops are made from the bar, by a recent patent process, the blade and strap being in one piece, not welded. All goods are American patterns.

Stencil Inks.

S. H. QUINT & SON.

Black. No.	Per can.	Per cake.	No.	Per can.	Per cake.
1	7 cents	3 cents	3	20 cents.	12 cents
2	10 "	5 "	4	30 "	20 "
Blue.					
1	10 cents.	6 cents	3	30 cents.	22 cents
2	15 "	9 "	4	50 "	40 "
Red and Green.					
1	12 cents	8 cents	3	50 cents.	42 cents
2	20 "	15 "	4	90 "	80 "

Per doz. cans or cakes, net, per gross, 10% less.

Indelible Ink.

Small bottles per	100	$2.75
" "	500	12.00
" "	1,000	20.00

STENCIL COMBINATIONS.

Contains Alphabet, Figures, Brush. and Ink.

⅛ inch, per doz		$5.00
¾ " "		5.40
1 " "		5.75
1¼ " "		7.50
1½ " "		8.40
2 " "		10.00
2½ " "		15.00

Dis., 10%.

Tools.

ARTISANS.

Chisel (Mason).

Stone, 5 and 8c. lb., net.

Mill Picks.

Cast steel. 2 to 3 lbs., $22 per doz. Dis., 60 and 5%.

Stone Axes, Cast Steel.

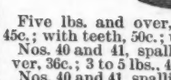
All sizes, 50c. per lb.

Dis., 70 and 10%.

Five lbs. and over, 40c.; with teeth, 45c.; 3 to 5 lbs., 45c.; with teeth, 50c.; under 3 lbs., 50c.; with teeth, 55c.

Nos. 40 and 41, spalling or stone hammer, 5 lbs. and over, 36c.; 3 to 5 lbs., 40c.; under 3 lbs., 45c. per lb.

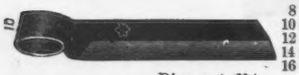
Nos. 40 and 41, spalling hammers, 9 to 20 lbs., steel face, per lb., 17c. Dis., 70 and 10%



Ship or Top Mauls, Steel Face, 4 to 8 lbs., 28c. per lb.

Dis., 50, 10 and 5%.

Steel Wedges, wood, 1st qual., 5c. lb.



Cooper Froes.

8 in..	℔ doz. $13.00
10 in..	℔ doz. 13.50
12 in..	℔ doz. 14.00
14 in..	℔ doz. 14.50
16 in..	℔ doz. 15.00

Discount, 60%.

60 days, 2% 10 days.

Vise.

No 1. Solid Box Vises.

	Each.
No. 25, 3⅜ in. Jaw	$12.00
" 30, 3½ "	11.00
" 55, 3⅝ "	10.00
" 40, 4 "	10.50
" 45, 4¼ "	11.00
" 50, 4¼ "	11.50
" 55, 4½ "	12.00
" 60, 4½ "	13.00
" 65, 4¾ "	14.00
" 70, 5 "	15.00
" 75, 5 "	16.00
" 80, 5¼ "	17.50
" 85, 5¼ "	18.50
" 90, 5½ "	20.00
" 95, 5¾ "	21.00
" 100, 6 "	22.00
" 105, 6 "	23.00
" 110, 6¼ "	24.00
" 115, 6¼ "	25.00
" 120, 6½ "	26.00
" 125, 6½ "	27.50
" 130, 6¾ "	29.00

	Each.		Each.
No. 135, 6¾ in. Jaw	$31.50	" 170, 7¼ in. Jaw	$44.50
" 140, 7 "	33.00	" 180, 8 "	47.00
" 145, 7 "	35.00	" 190, 8 "	53.00
" 150, 7 "	36.00	" 200, 8 "	56.00
" 160, 7¼ "	41.50		

Dis., 60 and 10%.

MINERS.

Coal Picks.

No.			Per doz.
16,	Weight, 2	lbs	$8.50
16,	" 2½	"	9.00
16,	" 3	"	9.50
16,	" 3½	"	10.00
16,	" 4	"	10.50
16,	" 4½	"	11.00
16,	" 5	"	11.50
16,	" 5½	"	12.00
16,	" 6	"	12.50
16,	" 6½	"	13.00
16,	" 7	"	14.00

Packages charged at cost.
Dis., 60%.

Adze Eye Coal Picks.
Same list and dis. as No. 16.

Anthracite Coal Picks.
Same list and dis. as No. 16.

Stone Picks, per doz.
No. 18, 6 to 7 lbs...$16.50.
No. 18, 7 to 8 lbs... 17.50.
No. 18, 8 to 9 lbs... 18.50.
Dis., 60 and 5%.

Adze Eye Miners' Picks—Surface, Drifting and Poll.

No.			per doz.
19,	Surface.	No. 1, 4 lbs	$14.00
19,	"	No. 2, 4½ "	15.00
19,	"	No. 3, 5 "	16.00
19,	"	No. 4, 5½ "	17.00
19,	"	No. 5, 6 "	18.00
19,	"	No. 6, 6½ "	19.00
19,	"	No. 7, 7 "	20.00
20,	Drifting,	No. 1, 3 "	12.50
20,	"	No. 2, 4 "	14.00
20,	"	No. 3, 4½ "	15.00
20,	"	No. 4, 5 "	16.00
20,	"	No. 5, 6 "	17.50
21,	Poll,	No. 1, 3½ "	15.00
21,	"	No. 2, 4 "	16.00
21,	"	No. 3, 4½ "	17.00
21,	"	No. 4, 5 "	18.50
21,	"	No. 5, 6 "	20.00
21,	"	No. 6, 6¾ "	21.50

Dis., 60, 10 and 5%.

Ore Picks.

No.		
54,	Adze Eye, 5 to 6 lbs	℔ doz. $12.00
54,	" 6 to 7 "	" $13.00
54,	" to 8 "	" $14.00

56, Steel Lake Superior Mining Pick

(Special Price and Quality.)

Dis, 60 and 10

Tamping Picks.

Adze eye, 6 to 7 lbs., per doz., $17.
Adze eye, 7 to 8 lbs., per doz., $18.
Adze eye, 8 o 9 lbs., per doz., $19.
Hunt eye, 6 to 7 lbs., per doz., $17.

Hunt eye, 7 to 8 lbs., per doz., $18.
Hunt eye, 8 to 9 lbs., per doz., $19.
Dis., 60 and 10%.

Steel Face Hammers.

No. 43, hand drilling hammers, 2 to 5 lbs.; No. 45, napping hammers, 2 to 5 lbs.; No. 39, mason hammers, 3 to 8 lbs.; No. 42, smiths' hand hammers, 2 to 5 lbs.; No. 44, smiths' striking hammers, 2 to 5 lbs., all steel face, per lb., 26c. Dis., 70 and 10%.

Steel Face Sledges.

No. 34. Smiths' sledges, 6 to 30 lbs., steel face, 17c. per lb.
No. 35. Stone sledges, 6 to 30 lbs., steel face, 17c. per lb.
No. 36. Striking sledges, 6 to 30 lbs., steel face, 17c. per lb.
No. 37. Coal sledges, 5 to 10 lbs., steel face, 18c. per lb.

Cast Steel Sledges.

No. 34. Blacksmiths' sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.
No. 35. Stone sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.
No. 36. Striking sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.
No. 37. Coal sledge, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.

No. 43, hand drilling hammer, 5 lbs. and over, 36c.; 3 to 5 lbs., 40c.; under 3 lbs., 45c. per lb.
Dis., 70 and 10%.

Cast Steel.

No. 42, blacksmiths' hand hammer, 5 lbs. and over, 30c.; 3 to 5 lbs., 34c.; under 3 lbs., 45c. per lb.
No. 44, drilling or striking hammer, 5 lbs. and over, 30c.; 3 to 5 lbs., 36c.; under 3 lbs., 45c. per lb.
No. 45, napping hammer, 5 lbs. and over, 30c.; 3 to 5 bs., 35c., under 3 lbs., 45c. per lb.
Dis., 70 and 10%.

RAILROADS.

Railway Track Punch

Round Point.
15c. lb., net.

Track Wrench.

7¾c. lb., net.

Rail Fork.

9c. lb., net.

Crow Bars.
Wedge Points, 3½c. lb., net.
Pinch Point, 3 ⅛c. lb., net.

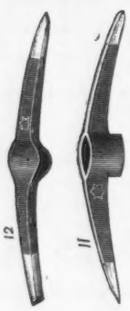
65 Tamping Bar, 6c. lb., net.

66 Claw Bar, 7c. lb., net.

Railroad Spike Mauls, 6 to 16 lbs., Steel Face 18c. lb.
Dis., 50, 10, and 5%.

Steel Track Chisel, 15c. per lb., net.

Railroad or Clay Picks.



No.			Per doz.
11,	Adze eye,	4 to 5 lbs	$11.00
11,	"	5 to 6 "	12.00
11,	"	6 to 7 "	13.00
11,	"	7 to 8 "	14.00
11,	"	8 to 9 "	16.00
11,	"	9 to 10 "	18.00
12,	Hunt eye,	4 to 5 "	11.00
12,	"	5 to 6 "	12.00
12,	"	6 to 7 "	13.00
12,	"	7 to 8 "	14.00

Dis., 60 and 10%.

Mattocks—Price per doz.
2, Adze Eye, Long Cutter, 6 lbs., $16.00.
3, Adze Eye, Short Cutter, 5½ lbs., $15.50.
2, Adze Eye, Long Cutter, Light, $15.00.
3, Adze Eye, Short Cutter, Light, $15.00.
4, Hunt Eye, Long Cutter, 6 lbs., $16.00.
5, Hunt Eye, Short Cutter, 5½ lbs., $15.50.

Adze Eye Pick Mattocks.....$16.

Hunt Eye Pick Mattocks.....$16

Dis., 60 and 10%.

Grub Hoes.

Western Pattern, No. 0, 3 lbs., ℔ doz., $10.50.
Western Pattern, No. 1, 3½ lbs., ℔ doz., $11.
Western Pattern, No. 2, 4 lbs., ℔ doz., $11.50.
Western Pattern, No. 3, 4½ lbs., ℔ doz., $12.
Baltimore Pattern, No. 1, 3½ lbs., ℔ doz., $11.
Baltimore Pattern, No. 2, 4½ lbs., ℔ doz., $11.75
Baltimore Pattern, No. 3, 5 lbs., ℔ doz., $12.75.
Baltimore Pattern, No. 4, 5¾ lbs., ℔ doz., $13.75.
Dis., 60 and 10%.

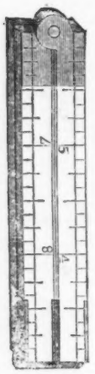
Shovels. C. S., long handle, round point.

Ames'.	Hobart's	Day's.
No. 1... 11.50	8.00	8.00
2....11.50	8.00	8.00
3....12.25	8.50	8.50

D. Handles round point.

2 . 12.00	8.50	8.50
3....12.50	9.00	9.00

Dis., 20, 10 and 5 %.



Tools, Carpenters'.

BOXWOOD RULES.

Two feet, four-fold, 1 inch wide.

Plate.	Middle.	Edge.	Bound.
Round joint.....	$4	...	...
Square "	5	$7	$15
Arch "	6	8	16

Two feet, four-fold, 1⅜ inches wide.

Plate.	Middle.	Edge.	Bound.
Square joint.....	$7	$9	$18
Arch "	9	11	20

Two feet, two-fold, 1½ inches wide.

Square joint.	Arch.	Arch Bound.
$5	$7	$16
12	14	24

Gunter's Slide.
Dis., 80, 10 and 10%.

LEVELS.

	10 to 16 in.	18 to 24 in.
Arch top plate, 2 side views..	$9.00	$12.00

PLUMBS AND LEVELS.
Arch top plate, 2 side views.

	12 to 18 in.	18 to 24 in.	24 to 30 in.
Polished	$14.00	$16.00	$18.00
Mahogany	....	16.50	22.50
Mahogany tp'd and lp'd	27.00	.....	.....
Polished and l pped	.....	.....	24.00
Polished and tipped	.....	.....	28.00
Polished, lip'd and tip'd	.....	.....	35.00

	in.	
Mason's level, 2 plumbs, polished,	36,	$30.00
Mason's level, 2 plumbs, p'd and t'd,	36,	36.00
Mason's level, 2 plumbs, polished,	42,	36.00

PATENT ADJUSTABLE PLUMBS AND LEVEL.

Arch Top plate, 2 side views	26 to 30 in.
Polished and lipped	$27.00
Polished and tipped	30.00
Polished, lipped and tipped	39.00
Mahogany	27.00
Mahogany, lipped	33.00
Mahogany, lipped and tipped	48.00
Polished, triple stock, lipped and tipped	48.00
Mahogany " " " "	60.00
Rosewood, lipped and tipped	90.00

Dis., 70, 10, 10%.

POCKET LEVELS.

Iron top, Japanned	2 50
Brass top	3.00

Dis., 70, 10, 10%.

SCREWDRIVERS.

Varnished handles, pat. metallic fastening.
Size 1½, $1 per dozen; 2, $1.50; 3, $2; 4, $2.50; 5, $3; 6, $3.50; 7, $4; 8, $4.75; 10, $6; $12, $8.
Dis., 75 %.

PLANES, BAILEY'S PATENT IRON.

Withipat. lateral adjustment.

Smooth, 8 in. × 1¾ in., $3; 9 in. × 2 in., $6.25; 10 in. × 2⅜ in., $3.75 each.
Jack, 14 in. × 2 in., $3.75.
Fore, 18 in. × 2⅜ in., $4.75
Jointer, 24 in. × 2⅝ in., $6.50 each.
Dis., 40, 10 and 10 %.

BAILEY'S PATENT WOOD PLANES.

Smooth.	Handle smooth.	
9 × 8¾ in.	8 × 2 in.	9 × 2 in.
$2	$2	$2.50 each
Jack.	Fore.	Jointer.
15 × 2⅛ in.	20 × 2⅜ in.	26 × 2⅝ in.
$2.50	$2.75.	$3.25 each

Dis., 40, 10 and 10%.

STANLEY IRON BLOCK PLANES.

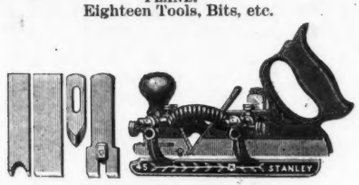
3½ × 1 in. 20c.
5½ × 1¼ in. 40c.
7½ × 1¾ in. 60c. each.

ADJUSTABLE.

5½ × 1¼ in. 60c.
7½ × 1¾ in. 85c. each.
Dis., 40, 10 and 10%.

STANLEY'S BEADING, RABBET, SLITTING AND MATCHING PLANE.

Eighteen Tools, Bits, etc.



$8 each. Dis., 20, 10 and 10%.

STANLEY "ODD JOBS."

Embraces in combination with ordinary Carpenters' Rule:

010 Try square.
020 Mitre square.
030 T——square.
040 Marking gauge.
050 Mortise gauge.
060 Depth gauge.
070 Mitre level.
080 Spirit level and plumb.
090 Beam compass.
0100 Inside square for making boxes and frames.

Price 75 cents.
Dis., 20, 10 and 10%.

TACK HAMMERS.

	Doz.
Magnetic, small	$1.25
Medium	1.50
Large	1.75

Discount, 30, 10, 10%.

MALLEABLE IRON.

Inlaid Handle.

Per Doz. $2.50

Discount, 30, 10, 10%.

STEAK HAMMERS.

Japanned	$2.25
X Plated	3.00

Discount, 30, 10, 10%.

Trucks.

New York Pattern.

Size.	Length of hdles. Ft.	In.	Width at nose. Inches.	Width at upper bar. Inches.	Size of wheel. Inches.	Price.
No. 0	3	6½	12	13¼	6½ × 1¾	$4.50
No. 1	4	1	13⅞	15⅝	6½ × 1¾	4.85
No. 2	4	5	15	16½	7¾ × 1⅞	6.00
No. 3	4	8	16	17¾	8¾ × 2¼	7.00
No. 4	5	0	16¼	17¾	9¾ × 2¼	8.00
No. 5	5	4	17¼	18⅞	10¾ × 2¾	9.50

Discount 50%.
Special net prices on quantity orders.

Tuyeres.

	No. 2.	No. 4.
	$25.00	$35.00 per doz.

20 % dis.

Valves.

Brass Globe and Angle Valves.

Size, inches	⅛	¼	⅜	½	¾	1
Star globe and angle valves	$0.80	$0.85	$0.90	$1.20	$1.55	$2.00
Star globe and angle valves, heavy patterns	...	...	...	1.50	1.95	2.80
Extra heavy Star and Lion patterns	...	...	...	2.00	2.60	3.60
All brass, yoke top	...	...	...	....	....	3.75
Cross valves	...	1.15	1.25	1.50	2.00	2.50
Star check valves	.70	.70	.75	.95	1.20	1.65
do. heavy pattern	...	...	...	1.15	1.50	2.00
Crescent globe and angle valves	.60	.60	.75	1.00	1.35	1.8
Crescent hose valves	...	...	...	...	...	...
check valves	.50	.60	.85	1.15	1.55	
Vertical check v'lv's	.50	.60	.85	1.15	1.55	
Jenkins globe and angle valves	1.10	1.25	1.60	2.20	2.80	
Jenkins check valv's	1.10	1.20	1.30	1.90	2.60	
Gate valves, Chapman	...	...	1.30	1.75	2.25	
Gate valves, other makes	...	1.00	1.20	1.75	2.50	
Brass safety valves	2.00	2.25	2.75	3.50	5.00	
Brass butterfly v'lv's	...	...	...	...	3.50	
Size, inches		1¼	1½	2	2½	3
Star globe and angle valves		$3.00	$4.00	$6.50	$12.50	$19.00
do. heavy pattern		3.95	5.30	8.35	14.00	22.00
Extra heavy Star and Lion patterns		5.40	7.20	10.80	18.20	28.60
All brass, yoke top		5.00	7.00	10.00	18.00	30.00
Cross valves		3.50	5.00	8.00	16.00	24.00
Star check valves		2.50	3.25	5.00	11.00	15.00
do heavy pattern		3.00	4.00	6.50	12.50	17.00
Crescent globe and angle valves		2.80	3.90	5.90	11.25	16.00
Crescent hose valves		4.00	5.50	7.00	10.00	....
" check valves		2.30	3.25	5.20	10.00	14.00
Vertical check valves		2.30	3.25	5.20	10.00	14.00
Jenkins globe and angle valves		4.00	5.50	8.00	15.75	22.00
Jenkins check valves		3.60	5.00	7.50	13.50	20.50
Gate valves, Chapman		3.25	4.25	6.25	11.50	16.00
" " other makes		3.50	5.00	7.50	15.00	22.00
Brass safety valves		7 00	8.50	12.00	20.00	30.00
Brass butterfly valves		4.50	5.50	8.00	11.00	16.00

Pressure Regulating.

Mason Regulator Co.

Size pipe.	Price.	Size pipe.	Price.	Size pipe.	Price
1 inch.	$22.	1¼ inch,	$28.	1½ inch,	$35.
2 "	44.	2½ "	57.	3 "	72.

Ludlow Valve Co.
Double Gate Brass Valves.
Gland in packing box.

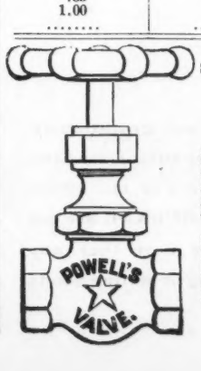
Size.	Screw socket.	Flange.	Diameter of Standard Flange.	Face to face of Screw socket	Face to face of Flanges.	Extra for slide stem and lever subject to discount.
In.	$	$	In.	In.	In.	
½	1.25	.....	.....	2¼	.....	$1.00
¾	1.65	.....	.....	2½	.....	1.00
1	2.15	.....	.....	2⅞	.....	1.00
1¼	3.15	.....	.....	3⅜	.....	1.00
1½	4.25	.....	.....	3¾	.....	1.00
2	6.25	11.50	6	4⅛	4⅝	1.00
2½	11.50	18.00	6½	4 13-16	5⅜	1.25
3	16.00	22.00	7	5	6¼	1.25
3½	21.00	31.00	7½	.....	.....	1.25
4	35.00	43.00	9	.....	7 1-16	1.25
5	52.00	64.00	10	.....	.....	1.25
6	78.00	90.00	11	.....	9	1.25
8	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....
12	.....	.....	.....	.....	.....	.....

Rubber-Faced Slide Gate Fire Hydrant.
See cuts on pages 19 and 20.

Diameter of pipe connection.	Diameter of stand pipe.	Diameter of seat ring.	One 2½ nozzle.	Two 2½ nozzles.	Three 2½ nozzles.
Inches.	Inches.	Inches.			
3 or 4	4⅝	3	$28	.....	.....
3–4–6	5¾	4	31	$33.00	$35.00
4 or 6	7	5	.....	38.50	40.50
6 or 8	8	6	.....	49.00	51.00
8 or 10	10	8	.....	.....	.....

Four 2½ nozzles.	Six 2½ nozzles.	One steamer nozzle.	One steamer and one 2½ nozzle.	One steamer and two 2½ nozzles.	Frost case, standard length.
.....	.....	.....	.....	.....	$4.50
.....	.....	$33.00	$35.00	$37.00	5.00
.....	.....	38.50	40 50	42.50	6.50
$53.00	.....	49.00	51.00	53.00	7.50

For each 6 inches more or less than standard length of stand pipe, add or deduct from list.	For each 6 inches more or less than standard length of frost case, add or deduct from list.	Extra charge for hub.	Independent nozzle gates each.
$0.60	$0.44	.....	.....
.75	.50	6 in. $0.50	$3.50
.85	70	No ch'ge	3.75
1.00	.90	8 in. $1.25	3.75
.....	.....	.....	4.50



Star Radiator Valves, with Brass T Handles or Wood Wheels.

Size, inches	½	¾	1
Plain brass	$1.60	$2.00	$2.50
Plated trim'gs.	1.80	2.25	2.80
Rough & Plat'd	2.00	2.45	3.05
Finish'd & P'l't.	2.50	3.00	3.65
Size, inches	1¼	1½	2
Plain brass	$3.60	$4.80	$7.50
Plated trim'gs.	3.95	5.20	8.00
Rough & Plat'd	4.20	5.50	8.50
Finish'd & P'l't.	4.95	6.50	9.75

Dis., 40, 10 and 5%.

Varnish.

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Edward Smith & Co.

For Finishing Coats.	gal.
Wearing body varnish	$5.50
Medium drying body	5.50
One coat coach varnish	4.50
Wearing carriage	4.50
Heavy gear varnish	4.00
Coach body "	4.05
No. 1 coach "	2.2

For Under Coats.

Hard drying body	$4.50	Black rubbing varnish	$4.00
Rubbing body varnish	4.00	Priming (1st coat)	2.50
Quick rubbing "	3.50	Filling (2d coat)	2.50
		Rough stuff	2.50

For Inside Work.

Best flowing varnish	$4.50	Hard oil finish light	$2.75
Best polishing "	4.50	" dark	2.25
Cabinet "	3.00	White copal	4.00

Dryers.

Japan gold size	$3.50	Brown japan	$1.25
Coach japan	1.75	Liquid dryer	1.25

Discount, 40 per cent, f.o.b. N. Y.

Preservative Coatings.

Spar coatings	$4.00	Exterior car coating	$4.00
I. X. L. No. 1	2.50	Interior car coating	3.25
I. X. L. No. 2	4.00	Locomotive coating	4.00
Floor finish	2.50		

Discount, 35 per cent, f.o.b. N. Y.

Watches.—Trenton Watch Co.

Open Face, Stem Wind and Set.

No. 51. Nickel Silver, Snap Back and Bezel $3.50

No. 55. Nickel Silver, Jointed Back and Bezel 3.75

No. 60. Nickel Silver, Bassine style, (Smooth Edges), Double Joints 4.25

No. 65. Dueber Silverine Bassine 4.50

No. 92. Silver, Engine Turned 6.37
No. 90. Silver, Engraved 6.50
No. 101. 14-karat Gold, Filled, Cases made of twoplates of 14-karat gold rolled on base metal, and warranted to wear for 15 years, Engine Turned 11.00
No. 102. Same, Engraved 13.00
Dis., 15 and 6% cash.

Wheelbarrows.

Climax Bolted Barrow, with Wood Wheel per doz. $22.50.
1½ tire of iron.
Common Nailed Barrow per doz. $18.50.
" Bolted " " " 18.75.

Lansing's Patent Iron-Bolted Barrow,	per doz.,		$25.50
Capital Patent Bolted Dirt	"	"	30.00
Red oak or Government	"	"	40.50
Wharf	"	"	72.50
Mortar	"	"	30.00
Bent Handle Stone	"	"	48.00
Coal or Ore	"	"	31.50
Pig Metal or Casting	"	"	40.50
Brick Yard 20 inch Iron Wheel	"	each	10.50
Globe Patent Bolted Garden Barrow Box 30 by 24 by 12 deep, wood wheel	per doz.,		42.50.

Capita Patent Barrows

With Iron Tray, A, per doz.,			$39.00
" " " B,	"	"	42.00

The Leader Iron and Steel Barrows.
Gas-pipe Legs and Handles in one price.

No. 1 Tray of 16 iron, capacity 3 cu. ft. of earth, each			$12.
No. 2 " " 14 " " 5 " " " "			
or 250 lbs. of coal			" 15
3 Galvanized 18 iron, capacity same as No. 2			" 1

Whiffletree.

Willson spring (Jeffery Manufacturing Company).

	Single.	Double.
No. 1, 34 or 36 inches long	$1.25	$2.50
No. 2, " " "	1.40	2.75
No. 3, " " "	1.50	3.00
No. 4, " " "	1.65	3.25

Including either steel hooks or rings.
Discount, 45 and 5%.

Whims—Horse.

Common Sense Steel.

F. O. B. $125.00
Dis., 25%.

Wick.

Baltimore Twine & Net Co.

Braided, all kinds, from..... 60c. to $1.00

LAMP.

0, or E	per gross	$0.40
1, or A	"	.60
2, or B	"	.75
3, or D	"	1.30
Brilliant, Argand and Crystal light	"	1.60
Deitz	"	.70
B—Double Thick	"	2.00
Pet Circular	"	.33
German Pet	"	.55
Moehring	"	3.00
Mann's Monarch	"	2.00
Dual	"	2.00
Duplex and Oxford	"	3.00
Wide Awake and Nutmeg	"	.40
Tom Thumb, Round and Flat	"	.25
Nos. 1 and 2 German Student	"	1.10
BB, or Bonanza	"	2.00
AA	"	1.50
Above, in 32-yard pieces		as per gross
Round Fluid	per doz.	$ .30
Wick in Boxes		3 cents extra

Dis., 60, 10, 5 and 3%.

CANDLE.

13 to 20 cents.

Windmills.

A. J. CORCORAN.

Patent Storm Defying Pumping Mills.

Wheel.	Weight, boxed.	Cubic feet.	Price.
8½ ft.	650 lbs.	55	95.00
10 "	700 "	75	120.00
12 "	900 "	95	150.00
14 "	1,350 "	135	250.00
16 "	1,850 "	195	375.00
18 "	2,150 "	250	450.00
20 "	3,500 "	335	600.00
	Dis., 25%.		
25 "	5,400 lbs.	450	775.00
	Dis., 20%.		
30 "	9,500 lbs.	795	975.00

Boxing for export extra.

Corcoran Storm Defying Geared Wind mills for Driving Machinery.

Price includes upper set of Bessemer steel gears, one length of shaft.

Dia.	H. P.	Weight.	Cu. ft.	Price.
16 ft.	2½	1,900 lbs.	200	$400.00
20 "	5	3,600 "	340	650.00
25 "	6½	5,400 "	355	850.00
30 "	8	9,600 "	816	1,150.00
36 "	10	12,000 "	856	1,500.00
40 "	12	14,500 "	896	2,000.00
50 "	30	16,500 "	956	3,500.00
60 "	40	20,000 "	1,015	4,500.00

Dis., 25%.

10 ft. pumping	....	$75
12 ft. "	....	95
14 ft. "	....	140
16 ft. "	....	225

Plus cost of packing.

Dis., 50 per cent.

Wire Cloth.

Newark, O., Wire Cloth Co.

Brass and Copper Wire Cloth.

No. Mesh.				Price per foot.	No. Mesh.				Price per foot.
2	from No. 10	wire	....	$2 50	20	from No. 26	wire	....	$.80
3	" 11	"	....	2.50	22	" 27	"	....	.80
4	" 12	"	....	2.50	24	" 28	"	....	.80
5	" 13	"	....	2.50	30	" 30	"	....	.65
6	" 14	"	....	2.50	40	" 32	"	....	.70
8	" 16	"	....	2.50	50	" 34	"	....	.75
10	" 18	"	....	2.00	60	" 35	"	....	.78
12	" 19	"	....	2.00	70	" 37	"	....	.70
14	" 22	"	....	1.10	80	" 38	"	....	.90
16	" 24	"	....	.80	90	" 39	"	....	1.10
18	" 25	"	....	.80		Dis., 60%.			

Wire Goods.

Fly Traps. Per gross.

Paragon..... $18.00

Balloon..... 15.00

Woodenware.

MASHERS.

Beefsteak.

Price, 70c. per dozen; barrels contain about 12 dozen.

Made out of Sugar Maple.

Potato.

Small size, 50c. per dozen; barrels contain about 30 dozen.

Medium size, 60c. per dozen; barrels contain about 15 dozen.

Large size, 70c. per dozen; barrels contain about 11 dozen.

Made ou Hard Sugar Maple and Wax Polished.

MALLETS.

Round Hickory.

	Per doz.	Barrels contain about.
No. 1, 2 to 2½ in.	$1.25	10 dozen.
" 2, 2½ to 3 "	1.75	8 "
" 3, 3 to 3½ "	2.25	5 "
" 4. 4 "	2.50	4 "

Round Lignumvitæ.

	Per doz.	Barrels contain about.
No. 1, 3 inches...	$3.00	6 dozen.
" 2, 3½ " ...	4.00	5 "
" 3, 4 " ...	5.00	4 "
" 4, 5 " ...	6.00	3 "

ROLLING PINS.

Packed in crates of one gross, and in boxes of one dozen. Solid and Loose or Revolving handles. Per dozen, $1.00.

SHOVELS.

Grain Scoops or Shovels (Wood).

Small size, price per dozen, $7.

Medium size, price per dozen, $8.

Large size, price per dozen, $9.

Made out of selected Hardwood, Maple, Beech and Birch. used for Grain, Malt, Potatoes, Fruit, etc.

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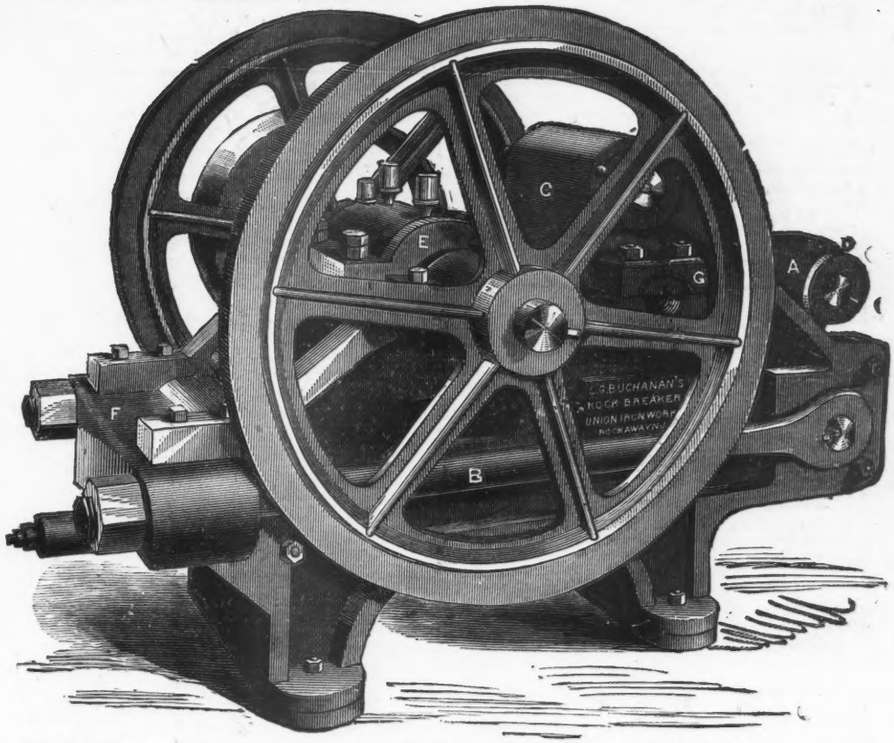

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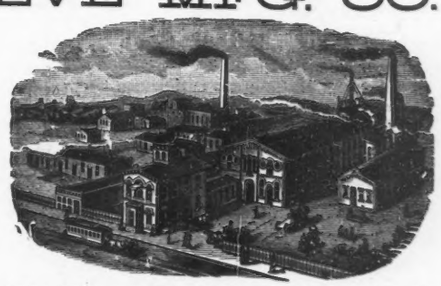

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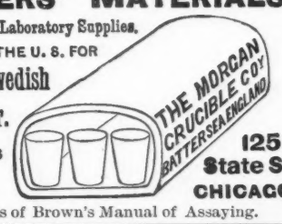

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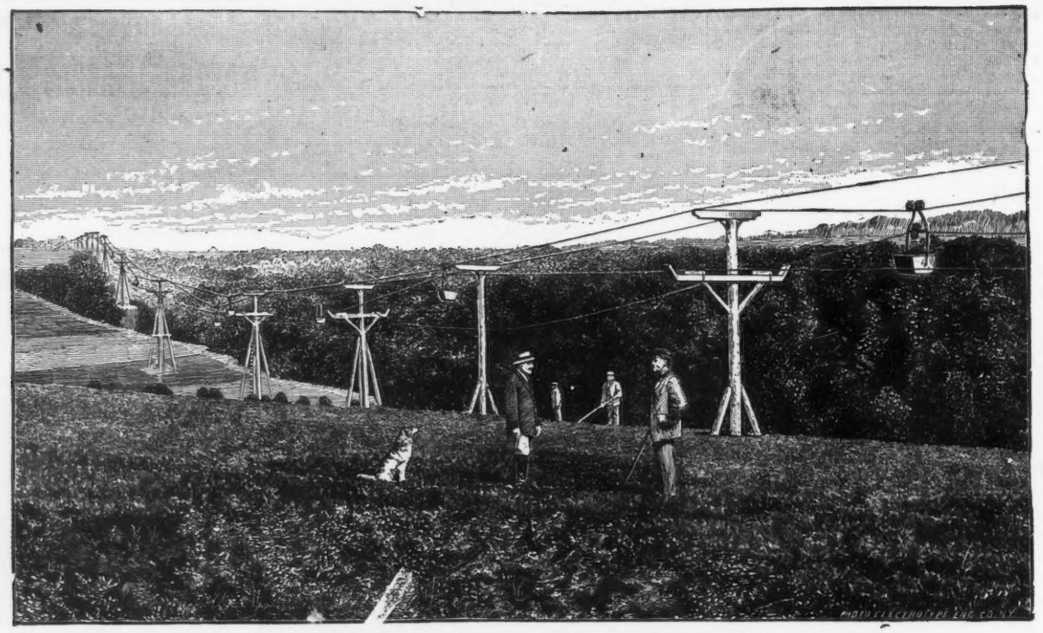

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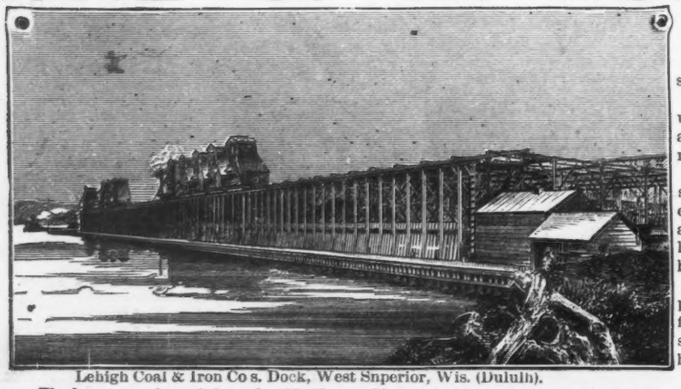

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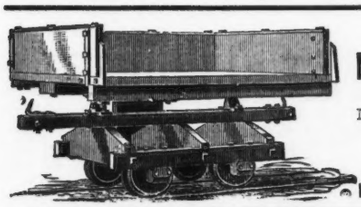
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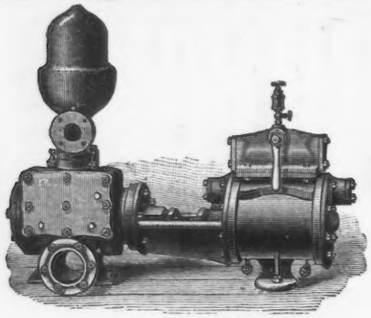

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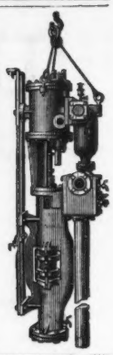

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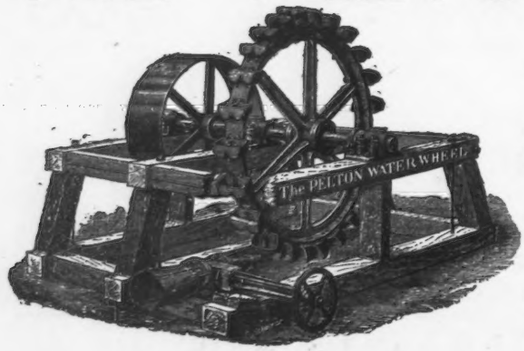

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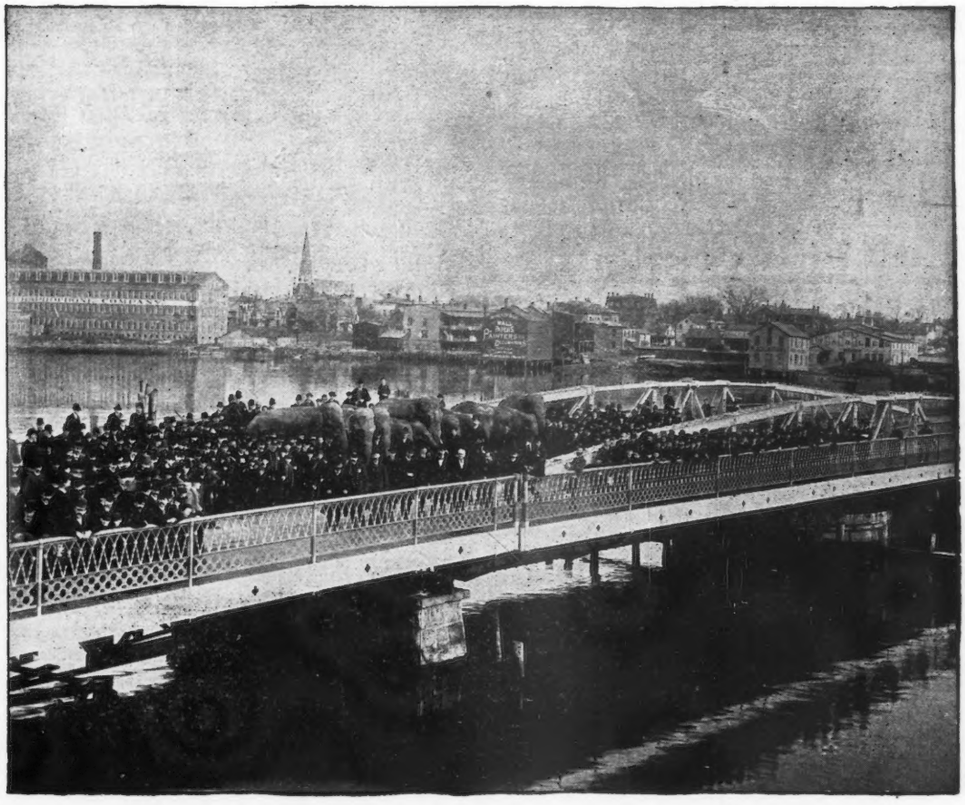

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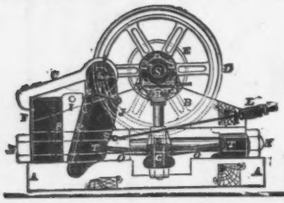

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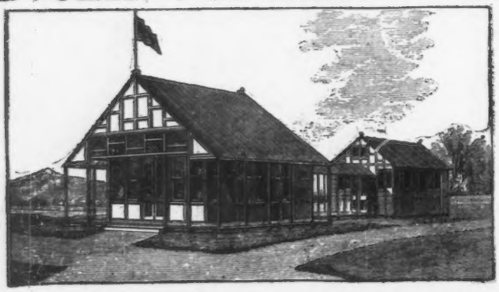

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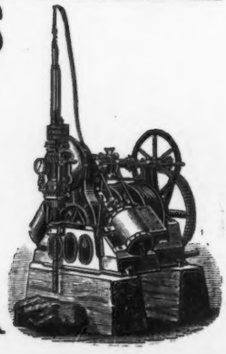

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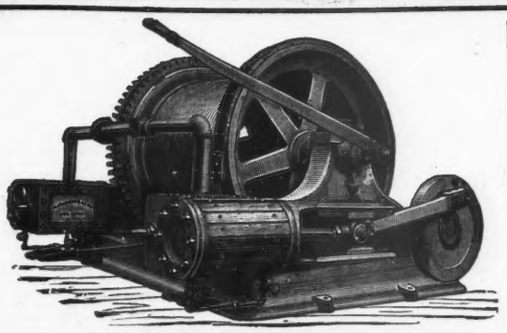

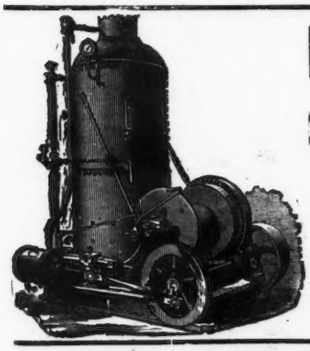

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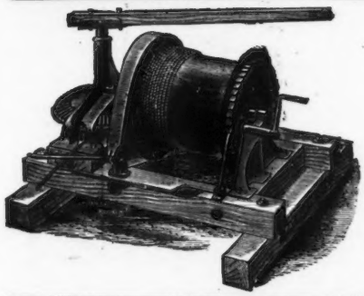

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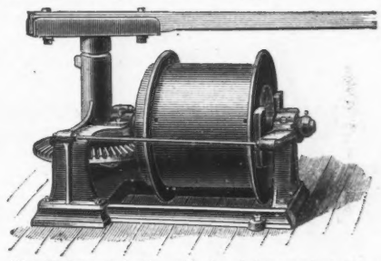

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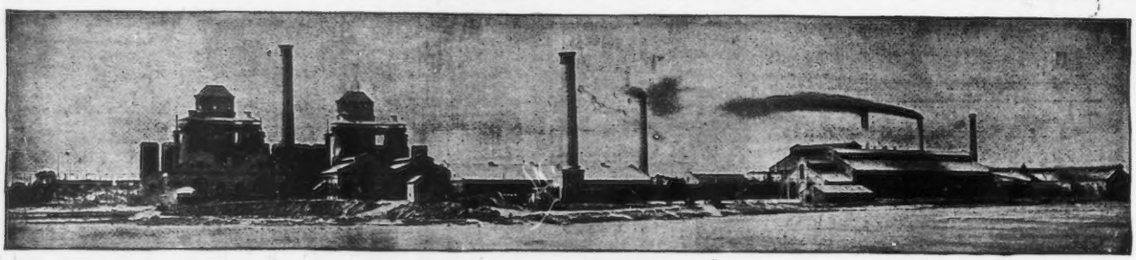

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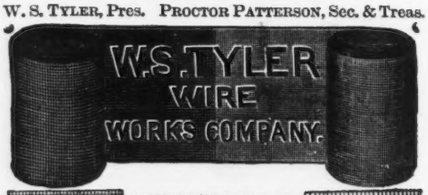

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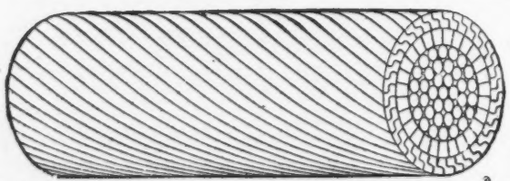

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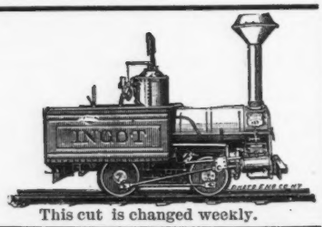

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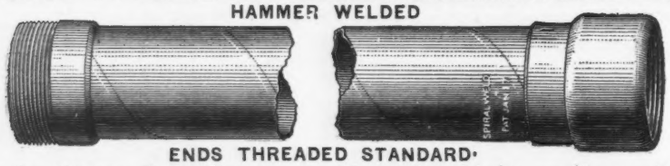

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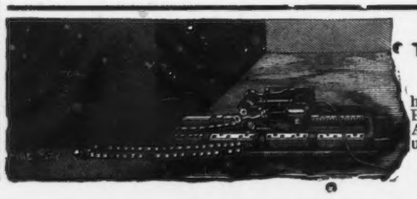

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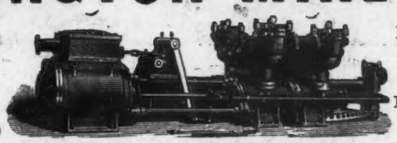

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